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# WATER QUALITY CONTROL STUDY CHAMPLAIN WATERWAY NEW YORK AND VERMONT: STUDY OF THE EFFECTS OF THE EXISTING CANAL WATERWAY AND PROPOSED PLANS OF CANAL IMPROVEMENT ON WATER QUALITY AND POTENTIAL WATER NEEDS FOR MUNICIPAL INDUSTRIAL AND QUALITY CONTROL PURPOSES

Public Health Service
New York, New York

March 1965

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# CHAMPLAIN WATERWAY
# NEW YORK AND VERMONT

STUDY OF THE EFFECTS OF THE EXISTING CANAL WATERWAY AND PROPOSED PLANS OF CANAL IMPROVEMENT ON WATER QUALITY AND POTENTIAL WATER NEEDS FOR MUNICIPAL, INDUSTRIAL, AND QUALITY CONTROL PURPOSES

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NEW YORK, N.Y.

MARCH 1965

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# WATER QUALITY CONTROL STUDY
# CHAMPLAIN WATERWAY
# NEW YORK AND VERMONT

Prepared
at the request of the
DEPARTMENT OF THE ARMY
U.S. Army Engineer District, New York, New York
for the use of
The International Champlain Waterway Board

A preliminary survey indicates that water quality levels consistent with desired future water uses would now prevail and will prevail in the future (with the exception of the proposed 27' deep canal) if (1) secondary waste treatment is provided and (2) if the available 7-day mean low flow once in 20 years for navigation is made available for water quality control. Future municipal and industrial water demands are expected to be met by increased utilization and development of existing sources. These conclusions are based on the results of economic and demographic studies regarding population and industrial growth.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Region II New York, N. Y.

MARCH 1965

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# I. INTRODUCTION

## Request and Authority

In a letter dated May 20, 1964, the New York District of the Army Corps of Engineers requested that the Public Health Service make an investigation of the Champlain Canal and Lake Champlain for the International Champlain Waterway Board to evaluate the effects of the proposed improvements to the Champlain Canal as they affect present and prospective needs for municipal and industrial water supply and for the regulation of streamflow for pollution abatement and water quality control.

This study has been made in accordance with the Memorandum of Agreement dated November 4, 1958, between the Department of Army and the Department of Health, Education, and Welfare, relative to the Water Supply Act of 1958 (Title III of Public Law 85-500 as amended by P. L. 87-88) and the Federal Water Pollution Control Act as amended (33 U.S.C. 466 et seq.), and the provisions of the Treaty of 1909 between the United States and Canada.

## Purpose and Scope

The purpose of this study is to determine the need for storage for municipal and industrial water supply and quality control along the Champlain Canal and Lake Champlain, and to determine the effects of the existing canal and proposed improvements upon the quality of these water bodies. The study area includes a ten mile strip on either side of the two waterways and is located in northeast New York and western Vermont. This report covers a study period to year 2020, as requested by the Corps of Engineers.

This is essentially a feasibility study and is limited in its depth of coverage. A more extensive study may be desired at a later date before action is initiated to improve the Champlain Canal.

## Acknowledgments

Grateful acknowledgment for the assistance and cooperation in providing data for this report is extended to the following agencies:

1. Vermont Department of Water Resources
2. New York State Department of Health
3. New York State Department of Public Works
4. Clinton County Health Department, New York
5. U. S. Army Corps of Engineers
6. U. S. Dept. of Interior, Geological Survey
7. Alexander Potter and Associates, Consulting Engineers

## II. SUMMARY OF FINDINGS AND CONCLUSIONS, AND RECOMMENDATIONS

### Summary of Findings and Conclusions

1. The International Joint Commission, Champlain Waterway Board is making a study of the International Champlain Waterway to determine the feasibility of canal improvements to facilitate increased navigational traffic.

2. Three alternate proposals to meet increased traffic needs are being considered. All three require increased navigation water demand at the summit level of the Champlain Canal. The Corps of Engineers has established that existing storage is available and adequate to supply increased navigational demands.

3. The Public Health Service was requested to evaluate the potential pollutional effects that may evolve in the Champlain Canal and Lake Champlain from development of the proposed improvements to the Champlain Canal, and potential municipal and industrial water supply needs in the study area.

4. The Champlain Canal and Lake Champlain are contained within the Upper Hudson River and Lake Champlain drainage basins which encompass a total area of approximately 11,300 square miles in northeastern New York and northwestern Vermont, and an estimated 1964 population of 600,000 people.

5. The study area for this report includes that portion of the Champlain Canal and Lake Champlain waterways from Waterford, New York north to the Canadian-United States international boundary and the adjoining 10 miles of land on either side. The study area which includes parts of 5 counties in Vermont (Grand Isle, Franklin, Chittenden, Addison, and Rutland) and parts of 5 counties in New York (Clinton, Essex, Warren, Washington and Saratoga) is shown in Figure III-1 following page IX-18.

6. The study area encompasses 3900 sq. mi. and had a 1964 population of 384,000 people. Approximately 47 percent of the population was urban.

7. Major cities in the study area and their 1960 populations were as follows: Plattsburg (20,172), Ticonderoga (5,617), Dannemora (6,141), Glens Falls (18,580), Hudson Falls (7,752) in New York and Burlington (35,531), Rutland (18,325), St. Albans (8,806), Winooski (7,420) in Vermont.

8. Average daily 1963 water use from municipal water supplies in the study area amounts to 34 mgd (million gallons per day) to supply a population of 244,000 or an average per capita use of approximately 140 gpd (gallons per day.)

9. Lake Champlain is a source of municipal water supply for several major water systems including Burlington and St. Albans, Vermont and Rouses Point and Wellsboro, New York. These communities serve an estimated 63,000 persons an average 6.5 mgd. By comparison available data does not indicate any municipality using the Champlain Canal waters for other than an emergency source of supply.

10. The total known municipal waste load discharged after various degrees of treatment within the study area in 1964 was equivalent to approximately 132,000 people or 33,000 lbs of ultimate biochemical oxygen demand (BOD) per day.

11. Industrial self-supplied water use in the study area in 1964 was estimated to be approximately 155 mgd. Approximately 29 percent of this total was for cooling purposes.

12. Based on an evaluation of economic information, the industrial waste load discharged after varying degrees of treatment within the study area was an estimated 549,000 lbs of ultimate BOD/day in 1964.

13. For more detailed discussions the study area was divided into two subareas: the Champlain Canal Sub-Area and the Lake Champlain Sub-Area.

14. The population of the study area will approach 790,000 by the year 2020 of which 76 percent will be urban.

15. The total municipal and industrial water demand, based on economic projections, will approach an estimated 400 mgd by the year 2020. Self-supplied industrial water use will comprise an estimated 260 mgd with 34 percent used for cooling purposes.

16. With increased utilization and development of existing surface (Lake Champlain, river, springs, and lake) and ground water supply sources, the expected future municipal and industrial water demands will be met without development of additional storage.

17. The future municipal and industrial waste load discharged to the study area following secondary treatment and disinfection of domestic wastes will be approximately 125,000 lbs of ultimate BOD per day. Industrial waste discharges are expected to discharge an estimated 99,000 lbs of BOD per day in 2020.

18. The flow used to evaluate current and future water quality conditions was 2160 cfs which is the 7-day mean low flow with a recurrence interval of 20 years in the Hudson River at Ft. Edward, N. Y. This flow is available from uncontrolled runoff supplemented by releases from existing structures including Sacandaga Reservoir.

19. The present classification of waters within the study area by the States of New York and Vermont are accepted for purposes of this report. The water quality indicator, dissolved oxygen (DO), was selected to represent water quality and the goal of no less than 4.0 mg/l (which is in keeping with New York and Vermont water pollution control regulations) was used in evaluating project effects.

20. Water quality conditions in the Champlain Canal Sub-Area, as determined by the Public Health Service field trip, were consistent with the water quality goal mentioned above.

21. Future water quality in the existing Champlain Canal will be seriously degraded and will not be adequate if existing waste treatment practices are continued. If secondary treatment of all wastes is provided, including disinfection of domestic wastes, together with provisions for maintaining the mean 7-day once in twenty year low flow, suitable quality conditions will be maintained for the duration of this study period to the year 2020.

22. Water quality conditions in the Champlain Canal, providing the flow of 2160 cfs in the Hudson River is maintained, would be as follows for the three Corps of Engineers proposals:

a. Alternate A will use the existing canal cross-section with a depth of 12 ft and have an increased flow to 267 cfs.

If the increased navigational water demand is provided by the Glens Falls Feeder, adequate water quality conditions will be maintained at present. By the year 2020, though, secondary treatment of all wastes with disinfection of domestic wastes will be necessary to maintain quality conditions in the Canal south of Ft. Edward to Waterford. Existing New York State treatment requirements will result in adequate water quality in the canal north of Ft. Edward to Whitehall.

If the increased navigational water demand is provided by the Hudson Falls Tunnel Feeder, adequate quality conditions in the Canal will be maintained at present and in the future only if secondary treatment of all wastes is provided including disinfection of domestic wastes.

If the increased navigational water demand is provided by a pumping station at Ft. Edward, secondary treatment of all wastes including disinfection of domestic wastes, will be necessary to maintain satisfactory water quality conditions both now and in the future.

b. Alternate B considers a channel depth of 14 ft a minimum bottom width of 270 ft and a navigational water demand of 1340 cfs fed by gravity from the Hudson River at Ft. Edward.

For this alternate, secondary treatment of all wastes including disinfection of domestic wastes is required to maintain satisfactory water quality in the Champlain Canal both now and in the future.

c. Alternate C considers a depth of 27 ft, a minimum bottom width of 250 ft and a navigational water demand of 1300 cfs fed by gravity from the Hudson River at Ft. Edward.

For this alternate, secondary treatment of all wastes including disinfection of domestic wastes with the mean 7-day once in twenty year low flow in the Hudson River supplemented by 500 cfs presently and 1000 cfs by the year 2020 is required to maintain satisfactory water quality in the Champlain Canal.

23. Sacandaga Reservoir together with uncontrolled runoff can supply the flows required by Alternates A and B for water quality control without further development. Alternate C will require additional development of storage to provide 1000 cfs.

24. The increased passage of commercial traffic would not significantly increase canal or lake loadings from domestic waste. Since the increased use of the waterway is primarily considered for through-traffic of commercial vessels, overnight docking along the canal or lake was not considered. If overnight docking along the canal or lake is considered, facilities should be provided at docks to receive liquid and solid wastes.

25. For the Lake Champlain Sub-Area, water quality in Lake Champlain as indicated by State reports was generally suitable for all present uses, with the exception of isolated shoreline areas which are subjected to discharges of inadequately treated wastes.

26. If designated ports are established along Lake Champlain to accept solid and liquid waste, including bilge water, from through vessels, there should be little change in existing water quality from increased commercial traffic.

27. Maintenance of satisfactory water quality in Lake Champlain and the Champlain Canal will benefit a wide spectrum of water uses, including recreation, propagation of fish and other aquatic life, and municipal and industrial water supplies.

Summary of Recommendations

1. It is recommended that a detailed study with full field work be made if either of the three proposals is to be implemented.

2. In those stretches in the canal where flow is totally dependent on lockages, it is recommended that sufficient flow be provided at all times to avoid stagnation, ponding or backflow conditions in the canal.

3. Since flow over waste weirs near locks along the canal has a beneficial effect on water quality by providing increased reaeration, it is recommended that in development of new structures or modification of existing structures excess flows be discharged over waste weirs as opposed to submerged discharges.

4. Boat owners and operators have a responsibility to treat their wastes just as municipalities and industries. Two methods of handling wastes from vessels are now available: Containment of wastes with eventual discharge to land-based treatment facilities or treatment of liquid waste with disinfection and discharge to the canal. Facilities for accepting solid and liquid wastes from vessels should be provided at locks along the canal and ports along the lake.

5. It is recommended that additional policing be provided to assure vigorous enforcement of current regulations on bilge water pumping to the canal and Lake Champlain.

# III. DESCRIPTION OF STUDY AREA

## Location and Boundaries

The international Champlain Waterway is an inland water route some 400 miles in length from the New York City harbors north to the St. Lawrence Seaway and includes waters of two major drainage basins, the Lake Champlain-Richelieu River and the Upper Hudson River, with a total drainage area of 11,300 square miles in the United States. Major waterways within this area include the Hudson River, the Champlain Canal portion of the New York State Barge Canal system, and Lake Champlain.

The study area is defined as the Champlain Canal and Lake Champlain and the adjoining 10 miles of land on either side from Waterford, N. Y. to the international boundary at Rouses Point, N. Y. This entails 178 miles of navigable lake and canal and a total drainage area of 3,900 square miles. It includes all or parts of 10 counties in New York and Vermont. Table III-1 lists these counties as well as the remaining counties in the drainage basin and Figure III-1 illustrates the study area and pertinent details.

For more detailed analyses, the study area was further sub-divided into two sub-areas described as follows:

Champlain Canal Sub-Area which encompasses the 10 miles on either side of the Champlain Canal from Waterford, N. Y. to Whitehall, N. Y. and includes those portions of Warren, Washington and Saratoga counties bordering the canal in New York.

Lake Champlain sub-area which encompasses the 10-mile area on either side of Lake Champlain from Whitehall, N. Y. to Rouses Point, N. Y. and includes those portions of Clinton and Essex Counties bordering Lake Champlain in New York and those portions of Grand Isle, Franklin, Chittenden, Addison and Rutland Counties bordering Lake Champlain in Vermont.

TABLE III-1

Drainage Basin Counties

I. Counties adjacent to Champlain Waterway

| New York | Vermont |
|---|---|
| Clinton | Grand Isle |
| Essex | Franklin |
| Warren | Chittenden |
| Washington | Addison |
| Saratoga | Rutland |

II. Remaining Counties in Drainage Basin

| New York | Vermont |
|---|---|
| Franklin | Orleans |
| Hamilton | Lamoille |
| Fulton | Washington |
| Rensselaer | Caledonia |

Topography

The Champlain Canal rises from approximately 15 ft elevation msl at Waterford to a summit level of 140 ft msl near Ft. Edward and then drops to 97 ft msl at Lake Champlain.

Lake Champlain lies in the northern part of the great trough extending from New York Harbor to the St. Lawrence River and receives drainage from the eastern slopes of the Adirondack Mountains and the slopes of the Green and Taconic Mountains.

The rugged, mountainous topography of the watershed accounts for the abundance of streams which drain into Lake Champlain. The major streams with drainage areas greater than 250 square miles are Otter Creek and the Mettawee, Poultney, Winooski, Lamoille, and Missisquoi Rivers which drain from the east, and the Bouquet, Ausable, Saranac and Great Chazy Rivers which drain from the west.

The Champlain Lowland, very narrow to the south and gradually widening to a maximum of about 25 miles in the north, slopes gently from an average elevation of about 300 feet in the south to about 120 feet in the north. The lowland, which is widest in Vermont, is a rolling country, characterized by sparse hills and low mountains, lakeshore terraces and delta plains, all dissected by numerous rivers and their tributaries.

Bedrock lies within 25 feet or less of the land surface on hilltops and hillsides, while in the valleys and lowlands adjacent to the canal it is generally found at greater depths. On the hilltops the bedrock is covered by a nearly continuous blanket of till. Till also overlies the bedrock in parts of the valley and lowland areas while the remaining deposits consist of interbedded deposits of sand and gravel, and clay and silt.

Ground Water

Along the Champlain Canal the ground water level is usually between 5 and 60 feet below the land surface. The yields of wells vary greatly depending on where water is encountered; that is, in bedrock or in unconsolidated materials such as sand and gravel. Yields from wells in bedrock formations vary widely depending in part on the type of overburden. The median yields from wells in all formations, however, seem to be about the same, from 2 to 4 gpm. Yields from wells in sand and gravel areas range from 2 to 1500 gpm and average 280 gpm.

Dissolved solids in water from sand and gravel deposits range from 78 to 497 mg/l; hardness as calcium carbonate ranges from 39 to 320 mg/l; alkalinity as bicarbonate averages about 200 mg/l; the pH ranges from 6.6 to 8.3.

Water from bedrock was found to contain more than 500 mg/l dissolved solids in about 1 of 4 samples. Moderately hard or very hard water (100 to 500 mg/l) can be expected about 50 percent of the time. The pH range (from 6.0 to 9.3) is slightly greater than that of water from sand and gravel.

The temperature of ground water in the area is nearly constant throughout the year, except in wells that receive water by infiltration from adjacent streams or in very shallow wells. Water from most wells that tap bedrock ranges in temperature from 49 to 53° F. Water from unconsolidated deposits usually is slightly lower in temperature.(17)

Hydrology

The U. S. Dept. of Interior, Geological Survey operates 23 stream gaging stations in cooperation with the States of New York and Vermont on various streams in the Lake Champlain Basin. This includes 15 gaging stations on rivers and streams in Vermont and 8 in New York. In addition, there are two recording gages on Lake Champlain, at Burlington and at Rouses Point. The maximum recorded water surface elevation of Lake Champlain published by the Geological Survey was 101.8 ft, msl, 1929 datum, recorded at Rouses Point on March 1903, and the minimum elevation, 92.17 ft was recorded at the same location on 23 October 1941. The maximum and minimum at Burlington were 101.5 ft and 92.61 ft on 28 March 1936 and 4 December 1908, respectively.

The Geological Survey locates 4 stream gaging stations on the Hudson River and numerous stations on tributary lakes and streams. Data on the most important of these is provided in Table III-2.

Sacandaga Reservoir, operated by the Hudson River - Black River Regulating District, is located on the Sacandaga River approximately 6 miles from its confluence with the Hudson River. This reservoir presently augments minimum flows in the Hudson River below Hadley as determined by the combined flow of the Hudson River and Sacandaga River below Hadley. Available drought flows from this reservoir and the Hudson River at Hadley are shown by Table III-3.

Climate

The climate in the study area is characterized by long, cold and snowy winters, relatively short moderate to hot summers, and transitional seasons of highly variable weather. Average annual temperature is about 45 degrees Fahrenheit with a temperature differential of about 50 degrees between the warmest and coldest months. Precipitation in the study area is typified by records at Whitehall, New York (2a) with an annual average precipitation of approximately 37 inches, a maximum of 46 inches and a minimum of 27 inches for 25 years of record.

TABLE III-2 - Data on USGS Gaging Stations

| No. | Location | Drainage Area- Sq. Miles | Records Available From | Average Discharge cfs | Min. Daily Discharge cfs | Min. 7-day Discharge 20 year Recurrence Interval cfs |
|---|---|---|---|---|---|---|
| 1-3185 | Hudson River at Hadley | 1664 | July 1921 | 2882 | 292 | 330 1/ |
| 1-3250 | Sacandaga River at Stewarts Bridge near Hadley | 1055 | Sep 1907 | 2038 | 6 | -- |
| 1-3270 | Glens Falls Feeder at Glens Falls | -- | Jun 1919 | -- | -- | -- |
| 1-3275 | Glens Falls Feeder at Dunham Basin | -- | Sep 1945 | -- | -- | -- |
| 1-3280 | Bond Creek at Dunham Basin | 14.7 | Jun 1947 | 17.3 | -- | -- |
| (61) | Hudson River at Mechanicsville | 4500 | 1887-1956 | 7246 | -- | 2050 2/ |

1/ Computed by Alexander Potter Associates from USGS data. USGS reports 393 cfs for 10 year occurrence interval.

2/ 10 year recurrence interval, 1931-1956.

TABLE III-3 - Available Flows from Sacandaga Reservoir and the Hudson River at Hadley

| Drought Recurrence Interval, years | Sacandaga Reservoir cfs | Hudson River at Hadley cfs | Total cfs |
|---|---|---|---|
| 20 | 1820 | 330 | 2160 |
| 30 | 1790 | 280 | 2070 |
| 40 | 1760 | 260 | 2020 |
| 50 | 1750 | 250 | 2000 |

Data provided by Alexander Potter Associates(7)

# IV. DESCRIPTION OF PROJECT

## Existing Canal System

The Champlain Canal, which is one segment of the New York State Barge Canal system, forms the connecting length between the Hudson River and Lake Champlain and extends from Waterford, N. Y. to Whitehall, N. Y. It has a total length of 61 miles and consists of 11 locks. The summit level of the canal, located near Ft. Edward just north of the confluence of the Hudson River and the canal, has an elevation of 140 ft msl. The canal flows south to Waterford and north to Whitehall from the summit level. The source of supply for the canal is presently the Glens Falls Feeder which diverts waters from the Hudson River above Glens Falls to the summit level and has a maximum capacity of 122 cfs.

Pertinent physical and hydrographic characteristics of the existing canal are summarized in Table IV-1 and are illustrated by Figure IV-1.

## Proposed Improvements

Improvements to the Champlain Canal include three proposals for varying volumes of traffic up to and including continuous passage. Basic characteristics of the three proposals are as follows:

### Alternate A

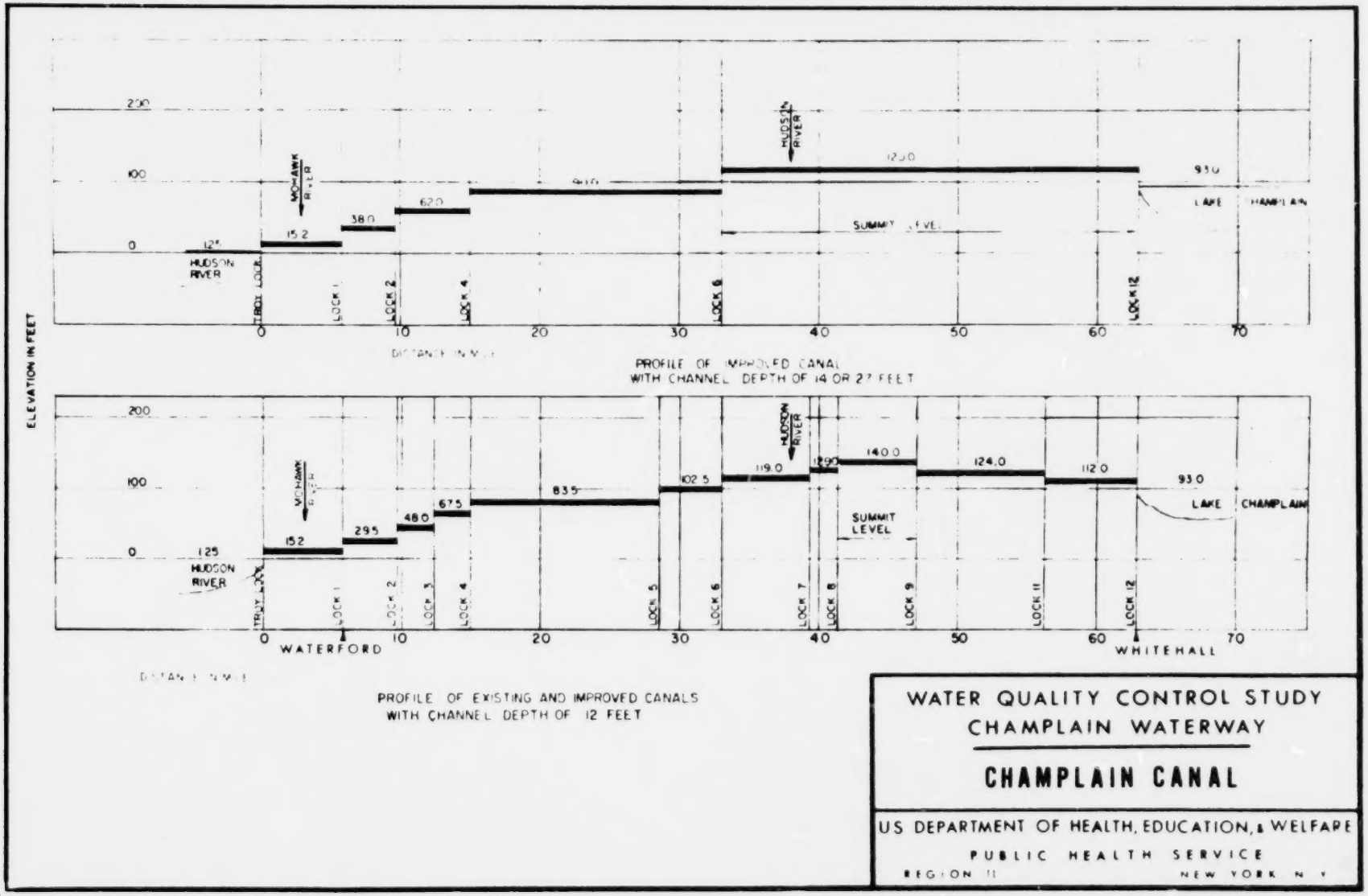
This plan primarily calls for repair in the existing locks of the canal and three plans for providing an increased navigational water supply demand of 267 cfs to the summit level. The existing channel dimensions and profile, as shown on Figure IV-1, will be retained.

The three plans for providing the 267 cfs needed for continuous passage are as follows:

1. reconstructing the present Glens Falls Feeder;
2. constructing a tunnel from the Hudson River at Hudson Falls for gravity flow to the summit level;
3. constructing a pumping station at Ft. Edward to raise water from the Hudson River into the summit level.

### Alternate B

This plan calls for deepening and widening of the existing canal dimensions and a reduction in the canal profile, Figure IV-1. The depth will be increased to 14 ft and the locks will have usable dimensions of 600 ft by 92 ft. The minimum, bottom width of the canal would be 270 ft. The summit pool elevation will be reduced from the existing 140 ft msl, to 120 ft msl, and the number of locks reduced from 11 to 5 with one lock between the summit level and Lake Champlain and 4 locks between the summit level and the Hudson River at Waterford. This eliminates six exist-




WATER QUALITY CONTROL STUDY
CHAMPLAIN WATERWAY

## CHAMPLAIN CANAL

US DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION II NEW YORK N Y

FIGURE IV—1

ing locks including Locks 3, 5, 7, 8, 9, and 11. The summit level of the proposed canal will be extended southward to Lock 6 so that the Hudson River will flow directly into the summit pool requiring no diversion structure.

The required navigational water supply demand to provide continuous passage is 1340 cfs for this alternate.

Alternate C

This plan also calls for deepening and widening of the existing canal dimensions and a reduction in the canal profile, Figure IV-1. The depth will be increased to 27 ft and the locks will have usable dimensions of 766 ft by 80 ft. The minimum bottom width of the channel would be 250 ft. The summit pool changes will be identical to those for Alternate B with the pool having an elevation of 120.0 ft msl and being extended to Lock 6. The number of locks eliminated is the same as for Alternate B. The required navigational water supply demand of this plan to provide continuous passage is 1300 cfs.

Table IV-1 summarizes the pertinent physical and hydrological data concerning the three alternates.

TABLE IV-1 - Characteristic of Existing Champlain Canal and the Three Proposed Improvements*

| | Existing | Proposed | | |
|---|---|---|---|---|
| | | A | B | C |
| Channel Depth (feet) | 12 | 12 | 14 | 27 |
| Bottom Width (feet) | | | | |
| River-cut Sec. | 200 | 200 | 270 | 250 |
| Earth-cut Sec. | 75 | 75 | 270 | 250 |
| Rock-cut Sec. | 94 | 94 | 270 | 250 |
| Total No. of Locks | 11 | 11 | 5 | 5 |
| From Summit Level to Whitehall | 3 | 3 | 1 | 1 |
| From Waterford to Summit Level | 8 | 8 | 4 | 4 |
| Lock Width (feet) | 45 | 45 | 92 | 80 |
| Lock Length (feet) | 328 | 328 | 600 | 766 |
| Summit Pool River Miles | C-38.6 to C-45.1 | C-39.6 to C-45.1 | C-30.1 to C-61.0 | C-30.1 to C-61.0 |
| Canal Water Supply | Feeder Canal from Hudson R. above Glens Falls | 3 proposals, Feeder Canal, Tunnel, Pump Station | Hudson R. direct feed | Hudson R. direct feed |
| Water demand for continuous passage (cfs) | 122 | 267 | 1340 | 1300 |
| Once in 50-yr minimum available supply (cfs) | 2000 | 2000 | 2000 | 2000 |

*Discussed in "Report on Water Supply Investigation Champlain Waterway" Alexander Potter Associates, Aug 28, 1964

# V. ECONOMY

## Introduction

Economic data presented in this section serve as a basis for estimating future municipal and present and future industrial water requirements and waste loadings as presented in latter sections of this report. A discussion of the general economic trends is herein given, followed by more specific economic and employment data for the study area and sub-areas.

## General

The Champlain Waterway is part of the International Waterway which links the St. Lawrence Seaway with the New York Harbors and also an important part of the New York State Barge Canal System which reaches across New York State into the Great Lakes area. Of economic importance is the shorter navigational route the canal provides for inland shipment of goods from the New York ports to up-state New York, Vermont and into Canada. The waterway presently transports petroleum, grain, coal and many manufactured products. For the barge canal system in 1961, petroleum and its products accounted for some 72 percent of the annual tonnage.

The Champlain Waterway drainage basin includes all or parts of 18 counties in New York and Vermont of which ten border the waterway. Industries in the ten county area are engaged in manufacturing, dairying, and agriculture. Some of the principal manufactured products are machinery, electrical appliances, foundry products, clothing and dairy and food products. Along the Lake Champlain shore in New York and Vermont are numerous resort and recreational areas which provide significant tourist trade.

## Study Areas

The water quality study area as defined previcusly includes approximately ten miles of land on both sides of the waterway, while the demographic and economic study area includes part or all of the ten counties adjacent to the waterway. The county data were broken down to include the general study area boundaries for the Lake Champlain section and the Champlain Canal section. The lake section is designated to include specific population and manufacturing employment trends for part or all of Clinton and Essex Counties in New York and Grand Isle, Franklin, Chittenden, Addison and Rutland Counties in Vermont that pertain to the study area. Similarly the canal section is designated to include pertinent portions of Warren, Washington and Saratoga Counties in New York.

## Present

The total drainage area in the United States to the Champlain Waterway is approximately 11,300 square miles containing a 1960 estimated population of 600,000. The 1960 population of the counties lying wholly or partially within the drainage area of the Champlain Waterway totaled 803,000. The 1964 population within ten miles of the waterway, shown in Table V-1, was 384,000 of which 47% was urban population.

Table V-1

Present Population Within The Study Area

| Sub-Area | Year 1964 | | |
|---|---|---|---|
| | Urban | Rural | Total |
| Champlain Canal | 66,200 | 58,900 | 125,100 |
| Lake Champlain | 113,800 | 145,000 | 258,800 |
| Total | 180,000 | 203,900 | 383,900 |

The study area has an estimated labor force of 132,000 of which 95% are employed. The economy of the area is diversified with the major portion of the labor force employed in manufacturing, in personal services and in trade industries. In 1964, 32,800 were employed in manufacturing. The Champlain Canal section is more heavily industrialized and reflects a greater intensity of manufacturing industries. More than 30% of the labor force are employed in manufacturing along the canal section; while the lake section has about 25% of the labor force engaged in service oriented industries and only about 21% in manufacturing. The major water using industries in both sections for 1964 comprise 37% of all manufacturing employment. This topic is discussed in further detail later in this section.

Demographic and Economic Projections

The population projections on which the economic analysis was developed were based directly on population projections made by the Corps of Engineers and presented in Table V-2. The analysis was based essentially on the assumption that where historical data indicate no growth or declining activity in any given industry, these industries would operate in the future at the level of employment at which they operated in 1960. This assumption applies particularly to the primary metals industry, the paper and allied products industry and textile mill products industry. This assumption appears to be valid because physical plants are in existence and are producing for established markets which would appear to sustain a demand for these products in the future. With this assumption in mind, available employment data were evaluated and forecasts prepared using Standard Industrial Classifications.

Future

By 2020 the population within the study area is projected to a total of 787,000 of which 76% will be urban. Manufacturing employment is expected to be 76,400 as compared to 32,800 in 1964. Manufacturing, however, is expected to employ smaller percentages of the total population in the future. The water using industries are expected to employ 32% of the total manufacturing in the area as compared to 37% in 1964. Figure V-2 gives the projected population to the year 2020 in the study area.

Table V-2

Future Population Within Study Area

| Sub-Area | Year 2020 | | |
|---|---|---|---|
| | Urban | Rural | Total |
| Champlain Canal | 241,900 | 28,500 | 270,400 |
| Lake Champlain | 353,400 | 163,300 | 516,700 |
| Total | 595,300 | 191,800 | 787,100 |

Champlain Canal Sub-Area

In 1964 the population within ten miles of the Champlain Canal was 125,100 of which 53% was urban population (see Table V-2). Major cities and their population (1960) are Glens Falls (18,580), Hudson Falls (7,752), Whitehall (4,016), South Glens Falls (4,129) and Ft. Edward (3,737) in New York. A total of 13,200 people were employed in manufacturing within the study area. Water using industries which include food and kindred products, textile mill products, paper and allied products, chemical and allied products, stone, clay, and glass products, and primary metals industries comprised 44% of all manufacturing employment and utilized 97% of the total industrial water demand. The largest water users in the area were paper and allied products and chemical and allied products industries which accounted for 95% of the industrial demand.

By the year 2020 the population of the Champlain Canal Sub-Area is projected to a total 270,400 of which 89% will be urban population. The total manufacturing employment in the area is expected to be 28,100 in the year 2020. Of the total employed in manufacturing, 38% will be employed in water using industries. Paper and allied products and chemical and allied products are expected to continue to be the largest water users comprising 87% of the total industrial water demand in 2020. However, in the economic development, no future growth of the paper and allied products industries over the 1964 level was anticipated, whether the canal is improved or remains in its present state. The total industrial water demand is expected to increase only 42% over the 1964 level which is the effect of growth in manufacturing industries exclusive of paper and allied products.

Lake Champlain Sub-Area

In 1964 the population within a ten mile influence of Lake Champlain was 258,800 of which 44% was urban population (see Table V-1). Major cities and their 1960 population are Plattsburg (20,172), Ticonderoga (5,617), Dannemora (6,141) in New York and Burlington (35,531), Rutland (18,325), Winooski (7,420), St. Albans (8,806) in Vermont. A total of 19,600 were employed in manufacturing in 1964. Water using industries which include food and kindred products, apparel, chemical and allied products, and furniture, lumber, wood products, comprise 32% of all manufacturing employment and utilize 52% of the total industrial water demand.

By the year 2020, the population is projected to a total 516,700, of which 68% will be urban population. The total manufacturing employment in the area is expected to be 48,300 in the year 2020. Of the total employed in manufacturing, 28% will be employed in water using industries. The total industrial demand is expected to increase 140% over the 1964 level.

## VI. WATER QUALITY OBJECTIVES AND CURRENT CLASSIFICATION

Quality determines the uses to which water can be put to assure high levels of public health, industrial development with associated economic benefits, recreational activities, and a suitable environment for fish and aquatic life, water quality must be maintained at satisfactory levels or improved to these levels. Accordingly, various agencies and groups have developed water quality goals which recognize varying levels of quality required by desired current and future water uses.

The states of New York and Vermont have established water quality objectives and both currently have progressive classification programs in operation. In a report entitled "Classifications and Standards of Water Quality and Purity," New York State outlines their water quality objectives and describes their classification system. An abridged version of this document is contained in Appendix A of this report.

Title 10 of the Vermont Statutes Annotated, Section 902, provides legislative authority for enactment of water quality objectives developed by the "New England Interstate Water Pollution Control Commission." An abridged version of these classification standards are contained in Appendix B.

The State of New York has presently classified all waters in New York within the study area of this report. Table VI-1 shows the present New York State classification and best use of the New York side of Lake Champlain. All waters have been classified as Class "AA", "A", "B", or "C."

With the exception of a few shore points and bay areas, the major portion of Lake Champlain waters north of the Toll Bridge at Crown Point are classified "A" or "AA" of good quality suitable as source of water supply. South of the Toll Bridge the waters become highly turbid and thus are classified "C."

Table VI-2 shows the classification of the Hudson River from its junction with the Champlain Canal at Ft. Edward north to its confluence with the Sacandaga River. This classification ranges from Class "B" to "D" with approximately fifteen percent of the river course considered as Class "D" water. Table VI-3 shows the classification of the Champlain Canal system. The classification ranges from Class "A" to "D" with approximately 80 percent as "A", "B", or "C", all of which require a minimum dissolved oxygen concentration of 4.0 mg/l.

The State of Vermont has classified all of the major tributaries to Lake Champlain and is in the process of classifying waters within the Lake Champlain Drainage Basin. Table VI-4 shows the completed classification of the Vermont side of Lake Champlain which is that portion of Franklin County south of latitude $44^{\circ}55'$. According to the classification, these waters have been designated as Class "B".

The U. S. Public Health Service concurs with and has selected for use in this report the water quality goal of 4.0 mg/l dissolved oxygen as used by the States of New York and Vermont.

TABLE VI-1 Lake Champlain - New York State Classification

| New York State Description | Character of District | Water Uses[a] | Best Use | Class[b] |
|---|---|---|---|---|
| All shoreside waters extending outward to a line in waters more than 30 feet and at least ¼ mile from any point of land from US-Canada boundary to the Lake Champlain Toll Bridge at Crown Point, with exception Deep Bay, Cumberland Bay, shoreside waters from Cumberland Bay to Ausable Point, Wellsboro Bay, North West Bay, and Bullwaga Bay. | Farming Residential Municipal Recreational Wooded | W, Rb, Rf | W | A |
| Deep Bay | Farms, Recreation | Rf, N | Rf | C |
| Cumberland Bay Part 1 | Residential, Recreation Municipal | Rb, Rf, D | Rb | B |
| Cumberland Bay Part 2 | Recreational, Residential | W, Rb, Rf | W | A |
| Shoreside waters from Cumberland Bay to Ausable Point, include areas around Crab Island and Valcour Island | Residential, Recreational Industrial | R, Rb, Rf | W | A |
| Wellsboro Bay | Wooded headland, farming, recreational | Wm, Rf, R, N | W | AA |

TABLE VI-1 Lake Champlain - New York State Classification (Cont'd)

| New York State Description | Character of District | Water Uses[a] | Best Use | Class[b] |
|---|---|---|---|---|
| North West Bay | Residential, Municipal, Rural | R, Rb, Rf | W | A |
| Bullwagga Bay | Farms, Recreational | Rf, N | Rf | C |
| Open reaches of Lake within N. Y. State from US-Canada border to Lake Champlain Toll Bridge at Crown Point, excluding previously mentioned sections. | -- | N, W | W | AA |
| Portion of Lake south of Lake Champlain Toll Bridge at Crown Point and including South Bay. | Farms, Recreation Residential | R, Rf | Rf | C |

(a) Explanation of Water Use Code

W-Water Supply
- Wm-Municipal Water Supply
- Wi-Industrial Water Supply
- We-Emergency Water Supply
- Wf-Fire Protection Water Supply

D-Wastes Disposal
- Dm-Municipal Wastes Disposal
- Di-Industrial Wastes Disposal

R-Recreation
- Rf-Fishing
- Rb-Bathing

N-Navigation

P-Power

A-Agricultural
- Ad-Drainage

(b) Refer to Appendix A for description of Classes

TABLE VI-2 Hudson River from Ft. Edward to confluence with Sacandaga River - New York State Classification

| New York State Description | Character of District | Present Uses[a] | Best Use[a] | Class[b] |
|---|---|---|---|---|
| Ft. Edward to Baker Falls | -- | Rb, W Industrial | Rb | B |
| Baker Falls to ¼ miles above Glens Falls | -- | Drainage | Drainage | D |
| ¼ mi. above Glens Falls to Sherman Island Dam | Woodland, Residential, Summer Cottages | R | Rb | B |
| Sherman Island Dam to dam at Spur Falls | Woodland | Rf, P | Rf | C |
| Dam at Spur Falls to dam at Corinth | Woodland, Residential, Industrial | Rf, Di, Dm P | Rf | C |
| Dam at Corinth to Trib. 369 (Sacandaga River) | Woodland, Residential, Summer Cottages | Dm, R, Wi | Rb | B |

(a) Refer to Figure VI-1 for explanation of water use code.

(b) Refer to Appendix A for explanation of Classes.

TABLE VI-3 Champlain Canal System - New York State Classification

| P. H. S. Mileage | New York State Description | Character of District | Present[a] Usage | Best[a] Usage | Class[b] |
|---|---|---|---|---|---|
| 0<br>C-9.8 | Trib. 240 (Mohawk River) to dam at Lock 3 | Farmland, municipal, industrial, sparsely populated | W, D, N, Rf, P | W | A |
| C-9.8<br>C-26.0 | Dam at Lock 3 to Trib. 301 (Batten Kill) | Farmland, residential, sparsely populated, summer cottages | R, D, N, Wi | Rb | B |
| C-26.0<br>C-35.2 | Trib. 301 d (Batten Kill) to Trib. 318 (Snook Kill) | Farmland, sparsely populated, residential, industrial | Rf, Wi, Di, N | Rf | C |
| C-35.2<br>C-37.4 | Trib. 318 (Snook Kill) to intersection of Champlain Canal | Woodland, farmland, major residential and industrial communities | Wi, Di, Dm, N | Rf | C |
| C-37.4<br>C-50.2 | Champlain Canal to Lock 9 | Farmland | N, Ad | Ad | D |
| C-50.2<br>C-61.5 | Lock 9 to mouth of Wood Creek | Farmland, residential area, village, hamlets | Rf, Dm, N | Rf | C |

(a) Refer to Figure VI-1 for explanation of water use code.

(b) Refer to Appendix A for explanation of classes.

TABLE VI-4 Lake Champlain - Vermont Classification

| Description of Waters | Present Conditions | Classification[a] |
|---|---|---|
| Lake Champlain in Franklin County south of Latitude 44°55' | B (with localized zones of C, D or below) | B |

Note: This is the only section of Lake Champlain within Vermont that is presently classified.

Vermont definition of Class B water:

Suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value; acceptable for public water supply with filtration and disinfection.

(a) Refer to Appendix B for explanation of classification.

## VII. BENEFICIAL WATER USES

Major water uses in the study area are primarily for municipal and industrial water supply, navigation, power and recreational purposes. Other uses include wastes disposal and agricultural needs. This section presents quantitative inventory data as regards principal municipal water supplies and municipal waste discharges within the study area along with qualitative descriptions of other uses.

An inventory of principal municipal water supply systems in the study area is presented in Appendix C. In 1963 these systems served approximately 244,000 people an average of 34 mgd for an average water use of 141 gpcd (gallons per capita per day).

An inventory of municipal and industrial waste discharges within the study area is presented in Appendix D. In 1963, municipal waste treatment facilities served 200,000 people. Of this total approximately 13 percent received secondary treatment, 69 percent primary treatment and 18 percent no treatment.

### Champlain Canal Sub-Area

As indicated from Table VI-3 the waters of the Champlain Canal are presently used for navigation, power production, drainage, recreation, industrial water supply and municipal and industrial wastes disposal. Best future uses according to New York State Law include water supply, bathing, fishing and agricultural drainage.

Before a municipality, industry or private group may use Champlain Canal waters they must secure a permit from the New York State Department of Public Works. These permits must be renewed annually. In 1963 permits were issued to municipalities for fire protection, sewage dilution and emergency water supply.

As noted in Appendix C, in 1963 there were 11 principal municipal water supply systems in the Champlain Canal Sub-Area. These systems served approximately 76,000 people with an average of 12 mgd for a per capita use of 158 gpd. None of the systems used the Canal as a supply.

As noted in Appendix D, municipal sewage treatment facilities served an estimated population of 72,700 people. Approximately 25 percent receive secondary treatment, 59 percent primary treatment and 16 percent no treatment.

### Lake Champlain Sub-Area

The waters of Lake Champlain are presently used for municipal and industrial water supply, recreation, including fishing and bathing, navigation and wastes disposal. Best uses on the New York side, according to New York State law, are for water supply, fishing, and bathing.

Navigation and transportation are still important uses, but are less today than before the Civil War, when the forests and mineral deposits were heavily worked.

Recreational fishing is an important activity throughout the lake, especially ice fishing which centers near Ticonderoga, Port Henry, Westport and Wellsboro.

Along the shores, private and public bathing beaches are numerous. Municipal beaches are located at Plattsburg, Westport and Port Henry.

Rouses Point, Wellsboro, Burlington and St. Albans are the major users of Lake Champlain as a direct source for municipal water supply. These communities serve approximately 63,000 people an average of 6.5 mgd. Other uses as a domestic water supply include most of the shore-front tourist cabins and summer cottages, as well as cabin cruisers on the lake.

Municipal water systems located within 10 miles of the Lake Champlain shore served approximately 168,000 persons an average of 22 mgd for an average per capita use of 131 gpd.

In 1963 municipal waste facilities within 10 miles of the Lake Champlain shore served approximately 128,700 persons, 83,300 on the Vermont side and 45,400 on the New York side. Approximately 19 percent of the wastes receive no treatment, 76 percent primary treatment and the remaining 5 percent secondary treatment. Accordingly, it is estimated that 23,000 lbs of ultimate BOD is discharged daily to the Lake.

On the New York side of Lake Champlain, Rouses Point discharges primary treated sewage into the lake and Port Henry discharges raw sewage. On the Vermont side, Burlington and Grand Isle discharge primary treated sewage into the lake. Other domestic wastes discharged to the lake include many septic tank effluents and small community or industrial wastes.

# VIII. WATER SUPPLY REQUIREMENTS

## Introduction

This section presents current and future water demands and sources of supply for municipalities and industries located within ten miles of land either side of the Champlain Canal and Lake Champlain. Table VIII-1 presents a summary of current and future water demands for the study area.

Municipal and industrial water demand considerations are presented first, followed by more specific discussion of current and future demands and sources of supply for each of the two major sub-areas: Champlain Canal and Lake Champlain.

## Municipal

Municipal water demands include all water used to meet residential, light commercial and public needs which are reasonably reflected in a per capita use.

For this report the present water demand includes all municipal water facilities listed in the 1963 Public Health Service inventory(18) within the study area. Accordingly, municipalities currently serve 244,000 people an average of 34 mgd, or 140 gallons per capita per day.

For future projections of water demand to the year 2020, allowances were considered for technological advances reflected in home appliances, recreational uses and commercial needs as well as trends toward more liberal water uses. Based on the present demand and trends from past data, an estimate of 200 gallons per capita per day for the Champlain Canal sub-area, and 175 gallons per capita per day for the Lake Champlain Sub-Area was used for future projections. Based on this estimate, municipalities within the study area will serve 758,000 people an average of about 143 mgd by 2020.

## Industrial

Industrial water demand includes the demands for water supply exerted by the principal water using industries.

No inventory data were available for industrial water use along the Champlain Canal and Lake Champlain. There is a sparsity of information regarding industrial waste discharges as indicated in Appendix D*. As a result of this lack of information, current and future estimates of industrial water demands are based on two factors: 1) The known and projected employment in various water using industries in Vermont and New York States and, 2) Average water use characteristics of the north-

*If industrial waste discharges were known, the industrial water demand could be estimated since demand equals waste discharge plus consumptive losses.

eastern region of the United States for specific water using industries. It is recognized that the industries considered in the estimates of current and future industrial water demands do not make up the total industrial employment. However, other manufacturing enterprises included in the analysis are not considered to be heavy water users and are the type that would most likely be supplied from municipal water systems.

As indicated in Table VIII-1, the self-supplied industrial water demand within the study area is currently estimated at 155 mgd, of which 29% is used for cooling purposes. Anticipated industrial expansion is expected to result in an increase in self-supplied industrial water demand to 260 mgd by the year 2020. An estimated 34% would be cooling water.

## Champlain Canal Sub-Area

### Current and Future Demands and Sources of Supply

Municipal water supplies currently serve 76,000 people an average of 12 mgd as indicated in Table VIII-1. By 2020, this demand is estimated to be 55 mgd serving a population of 275,000.

Based on the previously mentioned considerations, the self-supplied industrial water demand is currently estimated to be 115 mgd as shown in Table VIII-1. Approximately 30% is for cooling purposes. The largest users of this demand are the paper and chemical industries. These two industries accounted for about 93% of the current industrial water demand. In 2020 the total self-supplied industrial water demand is estimated to be 165 mgd, an increase of 43% over 1964. Cooling water would account for an estimated 27%. Paper and chemical industries are expected to continue to be the largest water-using industries making up to 87% of the self-supplied industrial water demand.

Within the ten mile study area along the Champlain Canal, 78% of the population is currently served by municipalities obtaining their water supplies from upstream surface sources, including springs, lakes, reservoirs and small streams. No municipality presently uses the Champlain Canal as a source of domestic supply. The remaining 22% is served from ground water sources.

Industrial establishments currently obtain water from surface sources including the Champlain Canal and Hudson River and their tributaries and from ground water sources.

Specific figures regarding developed dependable yields of surface and ground water supply sources were not available and beyond the scope of this report to develop. In this respect, then, the need for developing storage sites to meet future municipal and industrial water supply needs has been evaluated by investigating the yields and readily available lake, reservoir, and river sources. From this investigation it was found that the quantity of surface water readily available for development

significantly exceeds the total projected demand of 220 mgd in the Champlain Canal Sub-Area by the year 2020. For example, Lake George, with a relatively unlimited supply, is within close proximity of the Ft. Edward complex and is of good quality, requiring minimum treatment; Sacandaga Reservoir has a yield of over 1100 mgd (based on seven-day once in twenty year flow) and is readily available for use in the Ft. Edward complex; Saratoga Lake is available for development in the lower Champlain Canal area and has an adequate supply to meet foreseeable growth in the area; the seven-day mean once in twenty year low flow in the Hudson River is 220 mgd. While this flow could not be considered a usable municipal and industrial process water supply, it would be of such quality and quantity suitable to meet cooling water demand of 45 mgd.

Ground water is available in many areas along the Champlain Canal. The quantity of ground water is limited and varies according to where it is encountered; that is, in bedrock or unconsolidated materials (sand and gravel). Yields from wells in bedrock generally are under ten gallons per minute (gpm) while yields from wells in sand and gravel areas generally average in excess of 100 gpm. It is not expected that significant future demands will be met by development of ground sources.

The proposed improvements to the canal will not affect either surface or ground water sources presently available to municipalities and industries. Further, the projected water demands in the Champlain Canal Sub-Area are expected to be met by the full utilization of present sources and additional development of the readily available surface sources cited above.

## Lake Champlain Sub-Area

### Current and Future Demands and Sources of Supply

Municipal water supplies currently serve 168,000 people an average 22 mgd as indicated in Table VIII-1. By 2020, this demand is estimated to be 85 mgd serving a population of 485,000.

The industrial water demand is currently estimated to be 40 mgd, of which 27% is used for cooling purposes. By year 2020 the total industrial water demand is estimated to be 95 mgd, an increase of 140% over 1964. Cooling water comprises an estimated 25% of the total industrial self-supplied demand.

About 85% of the population within the ten mile study area along Lake Champlain is currently served by municipalities which obtain their supply from surface sources, including lakes, reservoirs, springs and streams. Ground water sources supply the remaining 15%. Among the major municipal water supplies using Lake Champlain are Burlington, Vt., St. Albans, Vt., Rouses Point, N. Y., and Wellsboro, N. Y. These communities serve approximately 63,000 people an average 6.5 mgd and are all in close proximity of Lake Champlain, with unlimited water supply.

Specific figures for developed dependable yields of surface and ground water sources of supply were not readily available nor within the scope of this report to develop. In this respect, an evaluation of existing sources of supply for present and future water demands is based on the close proximity of Lake Champlain as a source with an unlimited safe yield.

The quality or quantity of the sources of supply will not be affected by the proposed improvements to the Champlain Canal.

Because of the relatively unlimited capacity of Lake Champlain as a municipal and industrial water supply source within the limits of the Lake Champlain Sub-Area, there is no need for additional water supply storage.

Presently developed municipal and industrial supplies within the Lake Champlain Sub-Area provide an estimated 62 mgd. By 2020, it is expected that these supplies will be expanded and new supplies developed from available sources to meet the estimated total water demand of 180 mgd.

TABLE VIII-1. Present and Future Demands

| | Champlain Canal Sub-Area | Lake Champlain Sub-Area | Total for Study Area |
|---|---|---|---|
| Population Served | | | |
| 1964* | 76,000 | 168,000 | 244,000 |
| 2020 | 275,000 | 485,000 | 758,000 |
| Municipal Use (mgd) | | | |
| 1964* | 12 | 22 | 34 |
| 2020 | 55 | 85 | 140 |
| Industrial Use (mgd) | | | |
| 1964 | 115 | 40 | 155 |
| 2020 | 165 | 95 | 260 |
| Total Water Demand (mgd) | | | |
| 1964 | 127 | 62 | 189 |
| 2020 | 220 | 180 | 400 |

*Values taken from inventory data; all other figures are based on economic estimates and projections.

# IX. WATER QUALITY

## Introduction

This section presents an evaluation of current and future water quality for 61 miles of Champlain Canal and 435 square miles of Lake Champlain. Discussion of the present and future water quality of the Champlain Canal is based on the Public Health Service field study performed to characterize level of quality for 1963. An evaluation of water quality in the canal from increased commercial traffic and the most recent Corps of Engineers proposed canal improvements are discussed. From available data the current and future quality of Lake Champlain was considered. The rationale employed to evaluate current and future water quality conditions will be discussed. An evaluation of general water quality recommendations will be given first.

## Recommendations

An evaluation of the current water quality of the Champlain Canal and Lake Champlain and the possible effects the future design and operation of the system will have on future water quality has led to the general recommendations discussed below.

It is noted that the once in twenty year frequency of flows as calculated by Alexander Potter Associates are based upon continuous passage through the locks. Although this is most conservative as far as water demands are concerned, it does not necessarily hold true for water quality. As mentioned previously, the reaeration rate of a stream is a function of its velocity. For example, if the velocity is decreased the reaeration rate will be reduced all other things being equal. It is recognized that in the future navigation will probably increase and may attain the continuous passage level. However, if the level is not approached, it may be advisable to divert flows through the canal sections (non-river sections) to increase the velocity and reaeration rate, thereby avoiding stagnation or ponding and possible poor water quality conditions in these canal sections.

Calculation of the current and future water quality conditions considered the reaeration of canal flows as they passed over existing dams and locks. This means of discharging excess flows has a beneficial effect upon the quality of canal waters. It is recommended if new structures or modifications of existing structures are proposed that excess flows be discharged in this same manner as opposed to submerged discharges.

As mentioned previously, vessel owners and operators are expected to treat their wastes just as municipalities and industries. Two methods of handling such wastes are available: Containment of wastes with eventual discharge to land-based treatment facilities or treatment of wastes on vessels with direct discharge to the waterway. It is recommended that facilities for accepting wastes from vessels be provided at various locks and ports throughout the waterway. Additional policing should be provided to assure vigorous enforcement of current regulations on pumping of bilge water to the canal and Lake Champlain.

## Evaluation and Forecast Considerations

### Future Levels of Waste Treatment

It has been considered reasonable to expect that in the future secondary waste treatment or its equivalent, including disinfection of domestic wastes, will be provided by all municipalities and industries as well as commercial and recreation vessels.

The proper utilization of secondary biological waste treatment plants by municipalities and industries will remove about 85 percent of the oxygen demanding organic pollutants and also substantially reduce the suspended and settleable solids to the point where they generally will not pollute downstream waters. The disinfection of domestic wastes will substantially reduce bacteriological pollutants.

Thus, while current wastes loadings and resultant water quality conditions were evaluated in terms of existing levels of waste treatment, evaluations of future water quality were made based on at least secondary treatment or equivalent plus disinfection of domestic wastes regardless of the waste source.

### Water Quality Criteria

As mentioned in Section VI, quality determines the various uses of water. In the study area the future best uses of the waters are municipal and industrial water supply and recreation, including swimming and fishing.

The acceptability of water for its intended use is frequently determined by such parameters as concentrations of dissolved oxygen, solids, and bacteria and temperature.

In consideration of the extensive recreational use of the waters in the study area the dissolved oxygen content was examined most closely in this feasibility report. Although not a particularly important quality consideration in meeting out-of-stream water needs, dissolved oxygen is a significant factor in maintenance of an environment proper for fish and other aquatic life. However, maintenance of suitable dissolved oxygen levels to provide a desirable aquatic environment generally assures adequate water quality for out-of-stream users as measured by other parameters. Accordingly, dissolved oxygen has been used as the principal factor to estimate the effects of the proposed alternative plans on current and future canal and lake water quality and to estimate the effectiveness of present waste treatment facilities.

As previously noted, New York State has classified all the waters in New York State side of study area and requires a minimum of 4.0 mg/l dissolved oxygen for class C or better waters. Vermont classification of Lake Champlain and its major tributaries also requires a minimum of 4.0 mg/l DO. The Public Health Service concurs with this requirement and has therefore used 4.0 mg/l DO as the minimum allowable concentration.

It is recognized that a healthy aquatic environment includes adequate quantities of nutritional materials; however, the presence of excessive nutrients will disturb the environmental balance and may lead to undesirable conditions. Nutrient loads may be an increasing water quality problem in the future but are not expected to be affected by the proposed alternative plans. Accordingly they are not considered hereafter but will be taken into account by the Public Health Service comprehensive study projects.

Flow and Temperature

Flow and temperature, in addition to the level of dissolved oxygen, must also be specified for purposes of evaluating current and future water quality. While New York State usually employs the mean 7-day once in ten year low flow at 20°C (68°F), evaluations for purposes of this report are based on the minimum 7-day once in twenty years flow and a temperature of 24°C (75°F). This conservative approach is based on two factors: (1) Calculated flows for once in twenty year frequency for the entire length of the canal were readily available as a part of the Alexander Potter Associates report on the New York State Barge Canal.(7) The availability of these data and the conservative aspects of their use prompted the use of this frequency. (2) The second factor, a design temperature of 24°C (75°F), was selected after reviewing records which indicated that 24°C (75°F) commonly occurs during low flow conditions during late summer and early fall.

Reaeration Rate

The waste assimilation capacity of a stream or canal is dependent upon many variables, one of which is the reaeration rate ($K_2$). Similarly, the reaeration rate is dependent upon many variables including the flow in the stream or canal, velocity, and cross sectional area. For example, Proposal C designates an increase in the cross-section of the canal. For the same flows, such an increase in cross-sectional area will reduce the velocity and reaeration rate; hence the waste assimilation capacity of the canal will also be reduced. As a result, Proposal C was considered to produce the most adverse effects upon water quality in the canal.

Champlain Canal Sub-area

New York State's classifications for the Champlain Canal range from Class "A" to Class "D." The best future use along the canal, as designated by New York State Law, is primarily fishing. As indicated in Table VI-3, eighty percent of the canal waters have been classified as "A," "B," or "C," all of which require a minimum dissolved oxygen of 4.0 mg/l.

The character of the land adjacent to the canal includes farm and woodlands, small residential areas, as well as several larger communities. Current major water uses in this canal are waste disposal, industrial water supply, and bullhead and eel fishing to some extent. Also, a considerable number of pleasure boats use the Champlain Canal as a link between the lower Hudson River and Lake Champlain and Canada.

## Present Quality

The 1964 population in the Champlain Canal section of the study area was 125,000. Major communities and their 1960 populations include: Ft. Edward (3,737), Glens Falls (18,580), South Glens Falls (4,129), Hudson Falls (7,752), and Whitehall (4,016). Major water-using industries include paper and chemical and their allied products which employ 44 percent of the 13,200 people employed in manufacturing in the study area.

Based on the information contained in the municipal and industrial waste facilities inventory, Appendix D, municipalities serve an estimated population of 72,700. Approximately 84 percent of the wastes from this population receive at least primary treatment while the remaining 16 percent receive no treatment. Approximately 1/3 of the municipal wastes are chlorinated. As indicated in Appendix D, there are eleven known industrial establishments in the study area, nine of which are known to be discharging their wastes without providing any treatment. These are primarily paper and allied product firms.

The estimated total ultimate BOD load known to be discharged to the Champlain Canal in 1964 was 514,000 lbs per day, of which 10,000 lbs per day is contributed by municipalities, and 504,000 lbs per day by industries. Table IX-1 summarizes these data.

Water quality information for Champlain Canal is reported in the New York State classification reports[1a and 1b] for purposes of classification of waters included in the Lake Champlain drainage basin and the upper Hudson River drainage basin. The Public Health Service conducted a field investigation of water quality for the entire barge canal system during October, 1963 to update and supplement available data. Two samples were collected for each of 17 stations (located on Champlain Canal) and subjected to chemical, physical, bacteriological and biological analysis. Several specific analyses were performed including dissolved oxygen, chemical oxygen demand, fecal streptococci, and total coliforms. In addition, general screening analyses, including temperature, pH, conductivity, chlorides, and total alkalinity, were also employed. The field data analyses for the Champlain Canal are given in Appendix E. Station river miles indicate the location of sample from the zero point of the system at Waterford, New York. The mileages were calculated to correspond to those as published by the New York State Department of Public Works[4].

TABLE IX-1

Champlain Canal Sub-Area - Present and Future
Waste Loadings, Lbs of Ultimate BOD/Day

| Wastes | Present 1964 | Future 2020 |
|---|---|---|
| Municipal | 10,000 | 10,000 |
| Industrial | 504,000 | 83,000 |
| Total | 514,000 | 93,000 |

Analyses of the field trip data indicate the following general water quality conditions. Water temperature ranged from 12.9°C - 17.4°C with an average of 15.1°C (59°F). The lower temperatures occurred in the northern section toward Lake Champlain (C-32.7 to C-61.5). The pH ranged from 6.2 to 7.7 for the canal. The lower values in this range were recorded for the stretch below Ft. Edward (C-36.7 to C-24.8). Conductivity readings ranged from 70 to 150 with an average 160 umhos/cm.* Dissolved oxygen levels ranged from 4.7 to 9.0 mg/l with an average 77 percent of saturation. A drop in dissolved oxygen levels was noted below Ft. Edward (C-36.7 to C-29.6). Samples tested for alkalinity indicated a range of 7 to 54 mg/l with an average 25 mg/l in the canal. A drop in alkalinity was noted below Ft. Edward (C-36.7 to C-19.2). The chemical oxygen demand data indicated a range of 25 to 80 mg/l with an average 40 mg/l. Fecal coliform counts varied from 210 to 440,000 per 100 ml water. The higher values occurred near Whitehall and Waterford, New York, and below Ft. Edward (C-36.7 to C-19.2).

The Champlain Canal joins the Hudson River at Ft. Edward (C-37.4) flowing south to Waterford (C-0). In general, the Champlain Canal was of satisfactory water quality at the time of the field study in accordance with state regulations. However, due to the indicated lower pH, dissolved oxygen level, alkalinity and higher bacterial pollution in the canal below Ft. Edward, this area was considered a potential water quality problem area and is further discussed in the section entitled Ft. Edward Problem Area.

Future Quality

By the year 2020 the population within ten miles of the canal is expected to increase from the present 125,100 to 270,400. Manufacturing employment in the area in 2020 will increase from the present 13,200 to 28,100. Paper and chemical industries although expected to continue to be the major water-using industries will employ only 19 percent of the total employed in manufacturing as compared to 34 percent in 1964.

Assuming secondary waste treatment including disinfection of domestic wastes, the total waste loading discharged in the Champlain Canal Sub-area in 2020 will be 93,000 lbs of ultimate BOD as compared to the total of 514,000 in 1964. Of this total loading in 2020, 10,000 lbs are expected to be from municipalities while the remaining 83,000 lbs will be from industries. Approximately 70 percent of the total waste discharge in 2020, or 65,000 lbs of ultimate BOD per day, is expected to exist in the Hudson River at Ft. Edward as a result of upstream discharges to the Hudson River. Table IX-1 summarizes these data. Based upon the above future loadings and the mean 7-day once in twenty year low flow, it was determined that satisfactory water quality, consistent with the goal of 4.0 mg/l dissolved oxygen, would be maintained in the Champlain Canal in the year 2020.

Ft. Edward Problem Area

The Ft. Edward area, which is designated as the reach between Ft.

*micromhos per centimeter

Edward and Waterford, is currently a water quality problem area in the Champlain Canal. During the Public Health Service field trip in October, 1963, quality was generally degraded in this area by comparison with other sections of the canal. Since this area is presently a problem as regards water quality, an investigation was made to determine the quality in the future.

The Champlain Canal joins the Hudson River at Ft. Edward, C-37.4, and then flows south to Waterford, C-0. The field data indicated a sudden drop in dissolved oxygen concentration below the confluence of the canal and the Hudson River. At Station C-37.6, which is just above the confluence point, the dissolved oxygen was about 8.5 mg/l, while at Station C-31.4 a low of 4.7 mg/l was reported (See Appendix E). A corresponding rise in total coliform densities to a high of 110,000 per 100 milliliter and in fecal streptococci densities to a high of 1,200 per 100 ml occurred below Ft. Edward. Also, biological samples indicated that numerous sludge worms were present at Station C-36.7. A similar change in water quality occurred during the New York State Health Department's sampling program during May and June of 1959.

The total waste loading discharged in the immediate vicinity of Ft. Edward based on field data with an estimated flow of 2870 cfs in the Hudson River, and the Streeter-Phelps oxygen sag equation(6) was calculated to be 338,000 lbs of ultimate BOD. The total waste loading discharged within the Champlain Canal Sub-Area was an estimated 514,000 lbs of ultimate BOD per day with the major portion contributed by paper mill industries in the area.

If adequate waste treatment were provided meaning secondary treatment of all wastes including disinfection of domestic wastes, there would be no significant water quality problem in the Ft. Edward area under present conditions.

In the future, as previously mentioned in this section, it is assumed that all municipal and industrial waste discharges to the canal and its adjacent tributaries will receive secondary treatment including disinfection of domestic wastes. Projections of municipal and industrial waste loadings discharged following treatment in the Ft. Edward area in 2020 are estimated to be 64,000 lbs of ultimate BOD per day. Municipal waste treatment plants will contribute 4,000 lbs while the remaining 60,000 lbs will be from industrial waste treatment plants.

Based on the above assumed future loadings and the minimum 7-day once in twenty year low flow of 2160 cfs in the Hudson River at Hadley the dissolved oxygen in the Ft. Edward area will exceed 4.0 mg/l at the critical deficit point in the stream. Satisfactory disinfection of domestic wastes is expected to reduce the bacteriological densities in this problem area in the future. Also, the proper utilization of secondary waste treatment plants will reduce the solids content to the extent that sludge deposits will be reduced or prevented.

Although water quality is expected to be satisfactory at and below the confluence of the Hudson River and the Champlain Canal, consideration must be

given to that stretch of the canal from Ft. Edward to Whitehall. Flow in this section of the canal is determined entirely by navigational water demands. For this reason, particular attention is given to this portion of the canal for the three proposed improvements in the next section.

Effects of Project on Water Quality: Champlain Canal Sub-Area

The three alternates for improvement to the Champlain Canal have been discussed previously in Section IV, Project Description. Briefly, all three alternates involve methods of meeting increased navigational water demands facilitating increased commercial traffic. A general discussion of the water quality characteristics for each alternate is given first followed by a discussion of (1) the pollutional effect of increased navigational water use and physical changes to the canal and (2) the pollutional effects of increased commercial traffic. For purposes of brevity, two terms which are used frequently throughout this section are defined here:

Adequate Treatment -- secondary treatment with a BOD removal efficiency of 85 percent including disinfection of domestic wastes.

Design Flow -- the mean 7-day once in twenty year low flow in the Hudson River at Ft. Edward. This is equal to 2160 cfs.

Increased Navigational Water Use and Physical Canal Changes

The pollutional effects that may result in the Champlain Canal were considered for the three alternates under present conditions and projected future conditions with and without secondary treatment of wastes. Each condition has been evaluated for two flow circumstances: 1) resulting quality conditions with the design flow maintained in the Hudson River and 2) design flow augmentation to maintain satisfactory quality conditions in the canal with DO concentrations equal to or greater than 4.0 mg/l.

As a basis, the calculated total loading of 338.000 pounds of ultimate BOD per day from PHS field trip data was considered to typify water quality near Ft. Edward in the channelized section of the Hudson River. This load, projected up the Hudson River to the mouth of the proposed Hudson Falls Tunnel, represents a loading of 370,000 pounds of ultimate BOD per day.

Projection of waste loadings to the year 2020 considered economic forecasts and consideration of secondary treatment of all wastes. Total loadings of 64.000 pounds of ultimate BOD per day for the Hudson River at Ft. Edward and 70,000 pounds of ultimate BOD per day for the Hudson River at Hudson Falls were used to evaluate effects of the project on future water quality.

Alternate A

This alternate which entails no changes in the existing canal dimensions.

proposes three methods of delivering the increased navigational water demand to the summit pool. The present Glens Falls feeder can supply a maximum of 122 cfs to the summit pool. Alternate A requires a maximum of 267 cfs for continuous passage in the canal. The three proposed methods to deliver the increased navigational water demand have been evaluated separately regarding their effects on water quality.

Consideration was first given to the diversion of the needed 267 cfs for increased navigational water demands by the reconstructed Glens Falls feeder. This feeder draws its supply from generally good quality Hudson River water above the major industrial and municipal waste discharges. From calculations regarding the effects this modification would have on present and future water quality, it was found that.

(1) Under present waste loadings water quality conditions would not differ significantly from those now existing in the canal. Quality conditions in the canal presently meet existing New York State classification and the recommended minimum of 4.0 mg/l DO.

(2) To evaluate the effects of adequate present and future treatment, and to determine if a need exists for design flow augmentation in the Hudson River, additional field studies and investigation of existing waste treatment practices outside the study area defined for this report would be required. In this respect no evaluation is given for future quality conditions regarding this plan of supply.

The second proposed method for delivering the increased navigational water demand is by construction of a tunnel from the Hudson River at Hudson Falls for gravity flow to the summit pool. The quality of water in the Hudson River at this point has been degraded due to industrial and municipal waste discharges. As listed in Appendix D, there are three known municipal waste discharges and two known industrial waste discharges to the Hudson River between Hudson Falls and Glens Falls contributing an estimated 8,800 pounds of ultimate BOD per day. The total ultimate BOD load at this point has been estimated at 370,000 pounds per day. If this modification is used, it was found that,

(1) Under present waste loadings dissolved oxygen conditions below 4.0 mg/l would occur in the canal between Ft. Edward and Whitehall. The canal south of Ft. Edward to Waterford would be unaffected by the project.

(2) With adequate treatment of the present waste load, water quality in the canal between Ft. Edward and Whitehall would be degraded below the minimum DO level of 4.0 mg/l. The canal south of Ft. Edward to Waterford would be improved.

(3) In the future, water quality in the canal would be maintained at or above the recommended DO level of 4.0 mg/l if adequate waste treatment is provided and the design flow is maintained.

The third proposed method for supplying the 267 cfs needed for Alternate A is by construction of a pumping station at Ft. Edward to raise water from the Hudson River at approximate elevation 120 ft msl to the summit pool at elevation 140 ft msl. Although there is no additional waste load of 2,400 lbs of ultimate BOD discharged per day between Hudson Falls and Ft. Edward (see Appendix D) the quality of the Hudson River at Ft. Edward is of slightly better quality than at Hudson Falls due to the assimilative capacity of the river. Comparative ultimate BOD loadings are 370,000 lbs at Hudson Falls and 338,000 lbs at Ft. Edward.

If the Ft. Edward pumping station is used to supply the increased navigational water demand, it was found that

(1) Under present waste loading conditions water quality in the canal from Ft. Edward to Whitehall would be degraded with dissolved oxygen concentrations of less than 4.0 mg/l occurring over much of the canal. This condition is a result of the high organic loading imposed on the canal and little or no reaeration of the flow in the force main between Ft. Edward and the summit pool. The organic loading on the canal from this plan is approximately five times that which exists presently. The canal south of Ft. Edward to Whitehall would be unaffected.

(2) With adequate waste treatment water quality would be degraded in that portion of the canal between Ft. Edward and Whitehall with DO concentrations less than 4.0 mg/l.

(3) In the future, water quality in the canal would be maintained at or above the recommended level of water quality with DO concentrations greater than or equal to 4.0 mg/l, if adequate treatment of wastes is provided.

Alternate B

This alternate entails a modern barge waterway with a 14 ft. channel depth and a summit pool at elevation 120.0 ft msl. The summit pool will extend for approximately 30 miles, from Lock 6 to Lock 12, and will be fed directly from the Hudson River at Ft. Edward. The navigational water demand to provide continuous passage is 1,340 cfs.

The quality of the Hudson River at this point is similar to that previously discussed for the pumping station modification under Alternate A. The ultimate BOD load carried by the Hudson River at this point is estimated at 338,000 lbs. From calculations regarding water quality for this alternate it was found that

(1) Under present waste loading conditions, with a flow of 2160 cfs in the Hudson River at the canal intake point, water quality in the canal would be degraded with critical DO concentrations falling below 4.0 mg/l. This condition would occur because of the high organic waste loading imposed on the canal which exceeds

the canal's assimilative capacity for absorbing organic wastes. Adequate treatment of all wastes is required to maintain satisfactory water quality under present conditions.

(2) If existing treatment practices continue in the future, water quality in the canal would be seriously degraded with zero oxygen concentrations occurring for much of the canal length. DO levels above 4.0 mg/l would be maintained, though, if adequate treatment of all wastes is provided together with maintenance of the design flow.

Alternate C

This alternate considers a water demand at the summit level of 1,300 cfs, which is the maximum requirement for continuous passage through the canal. Proposal C will utilize the same canal profile, summit pool, and approximately the same flow as Proposal B. However, the channel will be twice as deep, and the average velocity will be reduced by two. This change will reduce the reaeration rate and increase the detention time, resulting in a much lower waste assimilative capacity in the deeper channel. The 30-mile summit pool organic loading, 185 lbs of ultimate BOD per acre per day, would exceed by four times the maximum loading recommended for facultative waste stabilization ponds, i.e. 20-50 lbs of ultimate BOD per acre per day. Dissolved oxygen concentrations ranging from very low to zero, odorous conditions and algal blooms from the organic enrichment would all result from this loading. From calculations regarding water quality for this alternate, it was found that,

(1) Under present waste loading conditions, serious oxygen depletion would occur as discussed previously. Adequate treatment of all wastes would still not raise the minimum DO level of 4.0 mg/l as recommended in this report and required by New York State Classification. An additional flow of approximately 500 cfs over the design flow is necessary to bring water quality in the canal up to the level recommended.

(2) In the future, very serious quality degradation would occur if existing treatment practices continue. With adequate treatment and flow augmentation of approximately 1,000 cfs, in excess of the 2160 cfs design flow, water quality would be maintained at or above the recommended level.

Increased Navigational Traffic

At present, travel through the Champlain Canal consists of recreational, state and freight craft. The number of passages for recreational craft during the 10 week summer season in 1962 was 778 at Lock 8 and 795 at Lock 9. For the remaining 22 weeks of the navigational season there were 155 passages at Lock 8 and 148 at Lock 9. Hence, the number of recreational craft passages averages about 11 per day during the 10 week recreational season and about 2 per day for the remaining 22 weeks of the navigational season. The total passages for state vessels in 1962 was 241 at Lock 8 and 96 at Lock 9. Hence,

the average passages per day was 1 at Lock 8 and less than 1 at Lock 9. For evaluations of pleasure and state craft using the Champlain Canal, Alexander Potter Associates consider 12 passages per day for pleasure craft and 2 passages per day for state craft.

Considerations were given to freight traffic by Potter and the maximum annual freight tonnage was established assuming continuous passage throughout the 32 week navigation season with loaded boats in one direction only.

The 12' channel would provide water supply for maximum freight tonnage over the 32 week navigation season of 13 million tons or an average 58 passages per day of freight traffic. Similarly the 14' channel provides 39 million freight tons annually or an average 43.8 freight passages per day, and the 27' channel provides 57 million freight tons annually or an average 34 freight passages per day. The existing canal is presently adequate for a maximum freight tonnage of 3.4 million tons. In 1962 an annual freight tonnage of 1.2 million tons was recorded at the summit locks with passage of 740 freight boats. For the 32 week navigational season this would be an average 3.3 passages per day freight traffic.

From these traffic conditions and a conservative consideration of 10 people aboard recreation and state craft and 30 people aboard freight craft, an estimate of population equivalents for domestic waste loadings were determined. Table IX-2 summarizes these calculations. The contribution of domestic waste at locks and along the canal from increased freight traffic on the canal would not significantly increase the BOD of the canal water; however, localized bacterial contamination could constitute health problems particularly near water supplies and recreation areas. For public health protection and aesthetic value of the canal waters, vessel owners and operators are expected to dispose of their wastes in a satisfactory manner, as noted previously.

The effects of oil discharges and spills from vessels on navigable waterways are not easily evaluated quantitatively; however, degraded water quality conditions do occur. Oily waters constitute a costly problem in treating water for domestic and industrial uses and provide an unnatural habitat for fish and wildlife. The State of New York and the Corps of Engineers presently have prohibitive regulations in effect regarding waste discharges and bilge water. Additional policing should be provided to assure vigorous enforcement of these regulations in view of potential pollutional problems that may result.

Lake Champlain Sub-Area

Lake Champlain, bordering Vermont and New York, extends from the southern tip near Whitehall to the international boundary, a navigable distance of 111 miles.

As previously discussed in Section VI, New York State has classified the western side of Lake Champlain and Vermont has classified part of the lake on the east. New York State has classified the major portion of the lake waters

TABLE IX - 2

Estimated Maximum Domestic Waste Loading in Canal
From Continuous Passage of Traffic

| | 12' Channel | 14' Channel | 27' Channel |
|---|---|---|---|
| Passage Time - min. | 20 | 25 | 30 |
| Passage per Day | | | |
| Recreation Craft | 12 | 12 | 12 |
| State Craft | 2 | 2 | 2 |
| Freight Craft | 58 | 43.8 | 34 |
| Total | 72 | 57.8 | 48 |
| Population Equivalents (For each lock) | | | |
| Recreation Craft | 1.7 | 2.1 | 2.5 |
| State Craft | 0.3 | 0.4 | 0.5 |
| Freight Craft | 24.2 | 22.8 | 21.2 |
| Total | 26.2 | 25.3 | 24.2 |
| # BOD/Day Contributed at each lock | 6.5 | 6.3 | 5.1 |
| No. of Locks | 11 | 4 | 4 |
| # BOD/Day for all locks | 72 | 25 | 20 |
| # BOD/Day Contributed in 61 mi. canal, craft travel 10 mph | 120 | 93 | 76 |
| Total Contribution to Canal # BOD/Day | 192 | 118 | 96 |

above the Lake Champlain Toll Bridge as Class "A" or "AA" and below the bridge as Class "C," all requiring a minimum dissolved oxygen of 4.0 mg/l. The State of Vermont is in the process of classifying waters within the Lake Champlain Drainage Basin. That portion of Franklin County south of latitude 44°55' has been classified as "B" waters, with not less than 75 percent of DO saturation.

The character of land adjacent to Lake Champlain varies from the larger cities of Burlington, Vermont and Plattsburg, New York to rural communities, farm and woodlands and numerous resort or recreational areas. Currently, the beneficial water uses of the lake include municipal and industrial water supply, fishing and bathing, navigation and waste disposal.

Present Quality

The 1960 population within the Lake Champlain section of the study area was approximately 263,000. Major cities and their 1960 populations include: Rutland, Vt. (18,325), Burlington, Vt. (35,531), and Plattsburg, N. Y. (20,172).

From the 1963 municipal waste facilities inventory, Appendix B, municipalities serve an estimated population of 128,700. Approximately 81 percent of the wastes from this population receive at least primary treatment and the remaining 19 percent receive no treatment.

The estimated ultimate BOD loading known to be discharged by all communities within 10 miles of Lake Champlain by municipalities is 23,000 lbs per day. The industrial waste loading in the study area is estimated to be 45,000 lbs of ultimate BOD per day. Table IX-3 summarizes these data.

The quality of the Lake Champlain waters in the broad and open reaches in the main lake are considered to be of good quality. The waters are generally used for recreational purposes; fishing, boating and bathing along the shores. The New York State Water Resources Commission (formerly Water Pollution Control Board) and the State of Vermont Water Resources Board are cognizant of local isolated shoreline pollution problems. Shoreline sampling programs are conducted by both agencies. Vermont has established some 250 sampling stations along the eastern shores of the lake which includes a bacteria sampling surveillance program at beach areas and sampling for classification.

According to the New York classification report of 1954,[1b] the waters in the broad, open reaches of the main lake are safe and clean. The waters in the narrow part of the lake, that part south of the Lake Champlain Toll Bridge near Bullwaga Bay, are not suited for fishing because of high turbidities. The waters at the outlet end (north end) present definite evidences of pollution. The shoreline waters, outside of the zones around stream mouths, boat anchorages, and concentrations of population, show no sign of sight or odor nuisance. Algae growths at the shoreline are caused by polluting materials from sources close by.

Specific areas where observed effect of discharge were noted have been described generally by the New York Water Pollution Control Board in the New York Classification Report of 1954 and the "Comprehensive Plan for Abatement of Pollution from Waters of the Lake Champlain Drainage Basin." These areas include Rouses Point, Cumberland Bay, Port Kent, Wellsboro, Port Henry, and Ticonderoga. Many municipalities and industries were cited by the New York State Water Pollution Control Board for needed or improved treatment facilities.

Reference is made to Table IX-4 which indicates water quality at the mouth of rivers confluent with Lake Champlain as reported in the 1954 New York State Classification Report.

The water quality on the Vermont side of the Lake is considered to be of good quality except for isolated area near St. Albans Bay, Burlington port and individual discharges along the shore. Water quality conditions at the mouth of eight rivers confluent to the lake taken from available information by Vermont Department of Resources is shown in Table IX-5.

The water quality in Lake Champlain near the confluence of the Champlain Canal is difficult to characterize because of the paucity of data in this regard. However, from visual observations it has been noted that this area is subject to algal blooms, high turbidities and in general, poor quality conditions at various times, most frequently in the summer months.

Future Quality

The population within the study area is expected to increase from 244,100 in 1960 to 516,700 by the year 2020. Manufacturing employment in the area is expected to increase from the 17,330 in 1960 to 48,300 by the year 2020. A major portion of manufacturing consists of the metal industry which employs 27 percent of the total manufacturing employment. The metal products industry is of the type that does not require large amounts of water, consisting primarily of fabricated metal products, machinery and electrical machinery and equipment manufacture. The primary metals industry employs only two percent of the total manufacturing employment. The major water industries in this area is in food processing for the manufacture of milk products and animal feeds. The paper industry generally a large water user, in this area is largely confined to manufacture of fabricated paper products, which is a relatively dry process.

Assuming secondary waste treatment including disinfection of domestic wastes, the total waste loading discharged in this section of the study area is estimated to be 32,000 lbs of ultimate BOD per day in 2020 as compared to the estimated 68,000 in 1964. This reduction in waste loading is a result of providing secondary waste treatment. As indicated in Tabke IX-3, in 2020 about half of the total waste discharged would be contributed by industries.

Effects of Project on Water Quality: Lake Champlain Sub-Area

The three Corps of Engineer proposals for improvement in the Champlain

TABLE IX - 3

Lake Champlain Sub-Area - Present and Future Waste Loadings, Lbs of Ultimate BOD/Day

| Waste | Present 1964 | Future 2020 |
|---|---|---|
| Municipal | 23,000 | 16,000 |
| Industrial | 45,000 | 16,000 |
| Total | 68,000 | 32,000 |

TABLE IX - 4

Water Quality at Tributaries Confluent with Lake Champlain New York Side of Lake*

| Water Course Mileage | Tributary | DO % Sat | BOD ppm |
|---|---|---|---|
| C-62 | Poultney River | 94 | 2.7 |
| C-62 | Champlain | 88 | 1.0 |
| C-60 | Mettawee River at Whitehall | 90 | 1.9 |
| NY-L-83 | Ticonderoga Creek Lake George Outlet at D&H R.R. - Mainline Bridge | 110 | --- |
| NY-L-136 | Ausable River at Ausable Chasm | 78 | 8.5 |
| NY-L-138 | Little Ausable River | 100 | 3.0 |
| NY-L-141 | Salmon River | 83 | 0.5 |
| NY-L-146 | Saranac River | 98 | 2.2 |
| NY-L-161 | Little Chazy River | 83 | 1.5 |
| NY-L-166 | Great Chazy River | 98 | 0.5 |

*Data taken from graphs at mouth of stream shown in NY Classification Report p. 107 - 149 (1951 - 1954)

TABLE IX - 5

Water Quality at Tributaries Confluent with Lake Champlain
Vermont Side of Lake*

| Water Course Mileage | Tributary | DO % Sat | BOD ppm |
|---|---|---|---|
| V-L-82 | East Creek | 62 | 1.4 |
| V-L-115 | Otter Creek | 83 | 1.5 |
| V-L-118 | Little Otter Creek | 92 | 2.3 |
| V-L-118 | Lewis Creek | 80 | 0.3 |
| V-L-134 | Winooski River | 110 | --- |
| V-L-136 | Malletts Creek | 115 | 0.9 |
| V-L-139 | Lamoille River | 88 | 1.7 |
| V-L-171 | Missisquoi River | 95 | 1.9 |

*Data taken from Vermont Department of Resources records (1957 - 58) for mouth of stream. Data is limited and may represent one sample.

Canal have been discussed previously in Section IV. Water quality characteristics for each proposal were enumerated earlier in this Section. The pollutional effects of the project on Lake Champlain water quality would be (1) potential localized pollution from discharge of the canal at southern tip of Lake Champlain and (2) pollution from increased commercial traffic through Lake Champlain. A discussion of these effects follows.

Increased Navigational Water Use and Physical Canal Changes

From Lock 12 near Whitehall the waterway follows the channelized section of the southern portion of Lake Champlain to Stony Point about 13 miles. From Stony Point to the Lake Champlain Toll Bridge near Bullwaga Bay about 20 miles of somewhat wider and deeper lake prevails. Beyond the Toll Bridge the waters widen and deepen to a maximum width of 12 miles and depth of 300 ft.

The narrow stretch of the Lake from Lock 12 near Whitehall to the confluence of South Bay, about 2-1/2 miles, would be more critically affected. The Poultney River discharges into Lake Champlain about a mile north of Lock 12 with minimum weekly flows that average about 20 - 50 cfs.*

*New York State Classification Report, Lake Champlain Drainage Basin.

Presently, the Champlain Canal discharges about 60 cfs at Lock 12 during the peak of the navigation season. Proposals A, B, and C indicate maximum discharges of 133, 670, and 650 cfs, respectively, excluding drainage from along the canal. For Proposal B and C this represents a 10 fold increase over present conditions.

The quality of the discharged water would be reflected in the quality of canal water at Whitehall. Calculations of water quality effects in the canal at Whitehall were developed for the three proposed improvements. A discussion of the effects that may develop in the southern portion of Lake Champlain follows.

Alternate A

This alternate considers the existing canal with a navigational water demand of 267 cfs fed by one of three sources: Reconstructed Glens Fall Feeder, Hudson Falls Tunnel, or Ft. Edward pumping station.

As discussed previously in this section, under present conditions the high organic loading imposed on the canal for the Hudson Falls Tunnel and Ft. Edward pumping station would not be assimilated in the twenty mile canal stretch from summit level to Whitehall and a degraded water with high BOD's and low DO's would be discharged to the narrow waterway in the southern portion of Lake Champlain. It is expected that this discharge will compound any existing problems concerning eutrophication and high organic levels. The amount of dilution available from the Poultney River, approximately 33%, would not significantly improve these conditions.

If adequate treatment of all wastes is provided, conditions at Whitehall would be improved and no problems would be expected in the Lake. Future considerations of organic loading (70,000 lbs of ultimate BOD per day) at Hudson Falls, including secondary treatment of wastes and use of available flows from Sacandaga Reservoir would provide acceptable water quality in the canal and would not add significant organic loading to the southern portion of Lake Champlain.

Alternate B

This proposal considers the summit pool at Ft. Edward to be fed directly by Hudson River. The summit pool extends north 24 miles to Lock 12 where approximately 670 cfs for continuous passage would be discharged to Lake Champlain.

The present high organic loading (338,000 lbs of ultimate BOD per day at Ft. Edward) will result in depleted oxygen for much of the 24 mile stretch with degraded conditions prevailing in the canal at Whitehall. The calculations of water quality at Whitehall for Proposal B are similar to that determined for Proposal A; however, five times as much water is released to Lake Champlain. Therefore, more critical water quality problems would be expected to occur in the lower reaches of Lake Champlain, such as high organic loadings, nutrient loadings and low DO's.

The future organic loading (65,000 lbs of ultimate BOD/day at Ft. Edward) following adequate treatment of wastes and use of available flows from the Sacandaga Reservoir will provide acceptable water quality at Whitehall and would not significantly pollute Lake Champlain.

Alternate C

With flow and loadings remaining the same, the increased channel dimensions for this proposed 27 ft deep channel as compared to Proposal B with 14 ft. channel depth will adversely affect water quality at Whitehall. The resulting decreased velocity, increased detention time and lower reaeration rate will result in lower quality canal water.

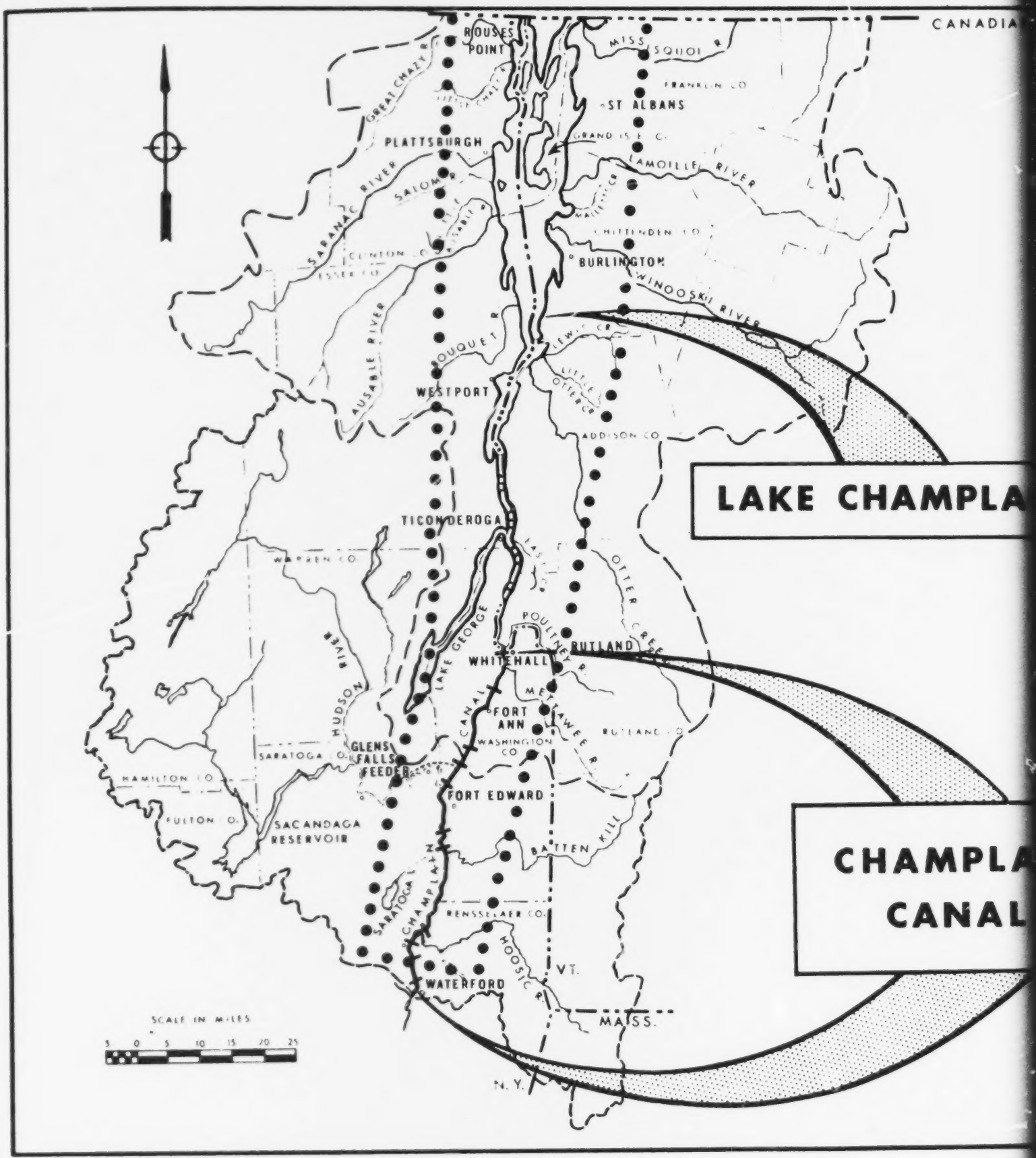
The present high organic loading (338,000 lbs of ultimate BOD per day at Ft. Edward) will result in near zero oxygen conditions for much of the canal from Ft. Edward to Whitehall requiring immediate construction of adequate treatment facilities. The calculations of water quality at Whitehall for Proposal C indicate lower quality water than for Proposal A or B. Therefore more serious water quality problems associated with high organic loadings and low DO's would result in the lower reaches of Lake Champlain.

The future organic loading (64,000 lbs of ultimate BOD per day at Ft. Edward) following adequate treatment of wastes and use of available flows from Sacandaga Reservoir, would provide acceptable water quality at Whitehall and no significant organic wastes discharged to Lake Champlain.

Increased Navigation Traffic

Since overnight docking of craft at ports along Lake Champlain is not expected to be a significant aspect of the proposed projects, the pollutional effects are considered for increased commercial traffic passing through Lake Champlain. Primarily, pollution to the waters will result from discharges of solid and liquid wastes along route. Travel through Lake Champlain consists of recreation, state and freight craft. Improvements to the Champlain Canal would primarily increase freight traffic of similar magnitude discussed for the Champlain Canal earlier in this section. Vessel operators are expected to provide disposal of their wastes in a manner to assure protection of public health and aesthetics. Two methods for accomplishing this are available and have been discussed previously. The estimated total contribution of domestic waste from vessels, after satisfactory treatment, is insignificant and would not constitute a problem.

As mentioned previously, the effects of oil discharges constitute a costly and aesthetic water quality problem. These oil discharges are likely to present more of a problem in the lake than the canal in recognition of the varied water uses of Lake waters. Additional policing by the States of Vermont and New York and the Corps of Engineers should be provided to assure vigorous enforcement of current regulations on pumping of bilge water to the Lake.


CANADIA
ROUSES POINT
GREAT CHAZY R.
LITTLE CHAZY R.
PLATTSBURGH
SARANAC RIVER
SALOMON R.
AUSABLE R.
CLINTON CO.
ESSEX CO.
WESTPORT
OUQUET R.
TICONDEROGA
WARREN CO.
HUDSON RIVER
LAKE GEORGE
CANAL
GLENS FALLS FEEDER
SARATOGA CO.
HAMILTON CO.
FULTON CO.
SACANDAGA RESERVOIR
SARATOGA
CHAMPLAIN
RENSSELAER CO.
WATERFORD
HOOSIC R.
VT.
MASS.
N. Y.
WHITEHALL
POULTNEY R.
FORT ANN
WASHINGTON CO.
FORT EDWARD
BATTEN KILL
MEETWEE R.
RUTLAND CO.
RUTLAND
OTTER CREEK
ADDISON CO.
LEWIS CR.
LITTLE OTTER CR.
BURLINGTON
WINOOSKI RIVER
CHITTENDEN CO.
MALLETTS CR.
LAMOILLE RIVER
GRAND ISLE CO.
ST ALBANS
FRANKLIN CO.
MISSISQUOI R.
LAKE CHAMPLA
CHAMPLA
CANAL
SCALE IN MILES
5 0 5 10 15 20 25

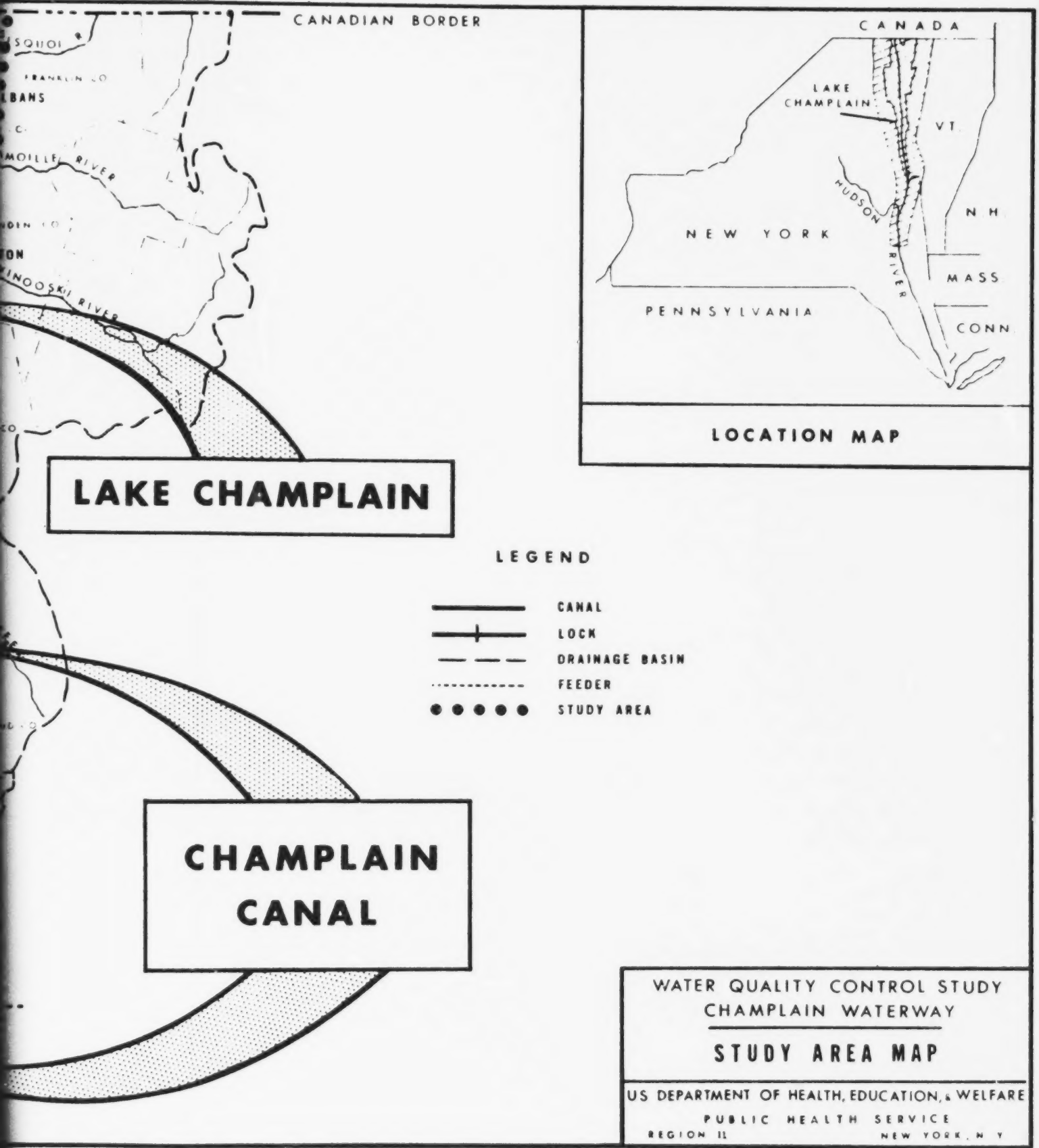

CANADIAN BORDER
SQUIOI
FRANKLIN CO
LBANS
MOILLE RIVER
INOOSKI RIVER
LAKE CHAMPLAIN
CHAMPLAIN CANAL
CANADA
LAKE CHAMPLAIN
VT
HUDSON RIVER
NEW YORK
N H
MASS
PENNSYLVANIA
CONN
LOCATION MAP
LEGEND
CANAL
LOCK
DRAINAGE BASIN
FEEDER
STUDY AREA
WATER QUALITY CONTROL STUDY
CHAMPLAIN WATERWAY
STUDY AREA MAP
US DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION II
NEW YORK, N Y

FIGURE III—1

# X. BIBLIOGRAPHY


1. New York State Department of Health Reports.

   a. Lake Champlain Drainage Basin Report.

   b. Upper Hudson River Drainage Basin Survey Series Report No. 2; Upper Hudson River Drainage Basin (except Hoosic River Drainage Basin).

2. New York New England Inter-Agency Committee Reports.

   a. Lake Champlain Drainage Basin, Part II, Chapter XXVII.

   b. Subregion "E," Hudson River Basin, Part II, Chapter XXXVII.

3. Vermont Water Resources Board Classification Order, Classification of Lake Champlain in Franklin County South of Latitude 44°55'.

4. New York State Department of Public Works, Division of Operations and Maintenance, Rules and Regulations Governing Navigational Use of the New York State Barge Canal System.

5. Sameson, A. L. H., Weirs and the Aeration of Rivers, Journal of the Water Engineers, Vol. II, No. 6, Office of the Institution, Parliament Mansions, London, England, 1957.

6. Fair, G. M. and Geyer, I. C., Elements of Water Supply and Waste-Water Disposal, J. Wiley and Sons, Inc. 1958.

7. Alexander Potter Associates, Consulting Engineers, Report on Water Supply Investigations Champlain Waterway, August 1964.

8. Arthur D. Little, Inc., The Effects on the Economy of Upper New York State of Modernization of the New York State Barge Canal, March 1963.

9. McKee, J. E. and Wolf, H. N., Water Quality Criteria, The Resources Agency of California, State Water Quality Control Board, Publication No. 3-A, 1963.

10. Tarzwell, C. M., Water Quality Criteria for Aquatic Life, Biological Problems in Water Pollution, U. S. Public Health Service, Sanitary Engineering Center, Cincinnati, Ohio, 1957.

11. Select Committee on National Water Resources, United States Senate, Future Water Requirements Municipal Use, January 1960.

12. U. S. Army Engineer District, New York, Great Lakes to Hudson River Waterway, New York, Interim Report No. 1, July 1962.

13. U. S. Department of Health, Education, and Welfare, Public Health Service, Drinking Water Standards, 1962.

14. U. S. Department of Health. Education, and Welfare, Public Health Service, Oxygen Relationships in Streams, Technical Report W58-2, 1958.

15. U. S. Department of Health, Education, and Welfare, Public Health Service, Pollution-Caused Fish Kills, 1961, 1962, and 1963.

16. U. S. Department of Interior, Geological Survey, Water Resources Division, Surface Water Records of New York, 1963.

17. U. S. Department of Interior, Geological Survey Water Supply Paper 1499-D, Water Resources of the Albany - Schenectady - Troy Area, New York by H. N. Halberg, O. P. Hunt and F. H. Pauszek, 1964.

18. U. S. Department of Health. Education, and Welfare, Public Health Service, 1963 Inventory, Municipal Water Facilities, Region I and II.

19. U. S. Department of Health, Education, and Welfare, Public Health Service, 1962 Inventory, Municipal Water Facilities, Region I and II.

20. U. S. Department of Commerce. Bureau of the Census, United States Census of Population 1960, New York and Vermont.

21. U. S. Department of Commerce. Bureau of the Census, Industrial Water Use, 1958 Census of Manufacturers.

22. U. S. Department of Health. Education. and Welfare, Public Health Service, Water Quality Control Study New York State Barge Canal System, Region II, New York. New York.

# APPENDIX A

# NEW YORK STATE CLASSIFICATIONS AND STANDARDS

# OF

# WATER QUALITY AND PURITY

# NEW YORK STATE CLASSIFICATIONS AND STANDARDS

# OF WATER QUALITY AND PURITY

## Class AA

Best usage of waters: Source of water supply for drinking, culinary or food processing purposes and any other usages.

Conditions related to best usage: The waters, if subjected to approved disinfection treatment, with additional treatment if necessary to remove naturally present impurities, meet or will meet U. S. Public Health Service Drinking Water Standards and are or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class AA Waters

| Items | Specifications |
|---|---|
| 1. Floating solids; settleable solids; oil; sludge deposits; tastes or odor producing substances. | None attributable to sewage, industrial wastes or other wastes. |
| 2. Sewage or wastes effluents. | None which are not effectively disinfected. |
| 3. pH. | Range between 6.5 and 8.5. |
| 4. Dissolved oxygen. | For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million. |
| 5. Toxic wastes, deleterious substances, colored or other wastes or heated liquids. | None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food processing purposes or impair the waters for any other best usage as determined for the specific waters which are assigned to this class. |

## Class A

Best usage of waters: Source of water supply for drinking, culinary or food processing purposes and any other usages.

Conditions related to best usage: The waters, if subjected to approved treatment equal to coagulation, sedimentation, filtration and disinfection, with additional treatment if necessary to reduce naturally present impurities, meet or will meet U. S. Public Health Service Drinking Water Standards and or will be considered safe and satisfactory for drinking water purposes.

Quality Standards for Class A Waters

| Items | Specifications |
|---|---|
| 1. Floating solids; settleable solids; sludge deposits. | None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto. |
| 2. Sewage or waste effluents. | None which are not effectively disinfected. |
| 3. Odor producing substances contained in sewage, industrial wastes or other wastes. | The waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto shall not have an increased threshold odor number greater than 8, due to such added wastes. |
| 4. Phenolic compounds. | Not greater than 5 parts per billion (Phenol). |
| 5. pH. | Range between 6.5 and 8.5. |
| 6. Dissolved oxygen | For trout waters, not less than 5.0 parts per million; for non-trout waters not less than 4.0 parts per million. |
| 7. Toxic wastes, oil, deleterious substances, colored or other wastes or heated liquids. | None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable as a source of water supply for drinking, culinary or food processing purposes or impair the waters for any other best usage as determined for the specific waters which are assigned to this class. |

Class B

Best usage of waters: Bathing and any other usages except as source of water supply for drinking, culinary or food processing purposes.

Quality Standards for Class B Waters

| Items | Specifications |
|---|---|
| 1. Floating solids; settleable solids; sludge deposits. | None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto. |
| 2. Sewage or wastes effluents. | None of which are not effectively disinfected. |
| 3. pH. | Range between 6.5 and 8.5. |
| 4. Dissolved oxygen. | For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million. |
| 5. Toxic wastes, oil, deleterious substances, colored or other wastes or heated liquids. | None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life, make the waters unsafe or unsuitable for bathing or impair the waters for any other best usage as determined for the specific waters which are assigned to this class. |

Class C

Best usage of waters: Fishing and any other usages except for bathing or as source of water supply for drinking, culinary or food processing purposes.

Quality Standards for Class C Waters

| Items | Specifications |
|---|---|
| 1. Floating solids; settleable solids; sludge deposits. | None of which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto. |

| Items | Specifications |
|---|---|
| 2. pH. | Range between 6.5 and 8.5. |
| 3. Dissolved oxygen. | For trout waters, not less than 5.0 parts per million; for non-trout waters, not less than 4.0 parts per million. |
| 4. Toxic wastes, oil, deleterious substances, colored or other wastes or heated liquids. | None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to fish life or impair the waters for any other best usage as determined for the specific waters which are assigned to this class. |

Class D

Best usage of waters: Agricultural or source of industrial cooling or process water supply and any other usage except for fishing, bathing or as source of water supply for drinking, culinary or food processing purposes.

Conditions related to best usage: The waters will be suitable for fish survival; the waters without treatment and except for natural impurities which may be present will be satisfactory for agricultural usages or for industrial process cooling water; and with special treatment as may be needed under each particular circumstance, will be satisfactory for other industrial processes.

Quality Standards for Class D Waters

| Items | Specifications |
|---|---|
| 1. Floating solids; settleable solids; sludge deposits. | None which are readily visible and attributable to sewage, industrial wastes or other wastes or which deleteriously increase the amounts of these constituents in receiving waters after opportunity for reasonable dilution and mixture with the wastes discharged thereto. |
| 2. pH. | Range between 6.0 and 9.5. |
| 3. Dissolved oxygen. | Not less than 3.0 parts per million. |
| 4. Toxic wastes, oil, deleterious substances, colored or other wastes, or heated liquids. | None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to prevent fish survival or impair the waters for agricultural purposes or any other best usage as determined for the specific waters which are assigned to this class. |

APPENDIX B

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION

CLASSIFICATION AND STANDARDS

OF

QUALITY FOR INTERSTATE WATERS

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION

Classification and Standards of Quality for Interstate Waters
(As Revised and Adopted October 1, 1959)

Class A

Suitable for any water use. Character uniformly excellent.

Quality Standards for Class A Waters

| Items | Specifications |
|---|---|
| 1. Dissolved oxygen | Not less than 75% saturation |
| 2. Oil and grease | None |
| 3. Odor, scum, floating solids, or debris | None |
| 4. Sludge deposits | None |
| 5. Color and turbidity | None |
| 6. Phenols or other taste producing substances | None |
| 7. Substances potentially toxic | None |
| 8. Free acids or alkalies | None |
| 9. Radioactivity | Within limits approved by the appropriate State agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between States involved. |
| 10. Coliform bacteria | *Within limits approved by State Department of Health for uses involved. |

*Sea waters used for the taking of market shellfish shall not have a median coliform content in excess of 70 per 100 ml.

## Class B

Suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value. Acceptable for public water supply with filtration and disinfection.

| Items | Specifications |
|---|---|
| 1. Dissolved oxygen | Not less than 75% saturation. |
| 2. Oil and grease | No appreciable amount |
| 3. Odor, scum, floating solids, or debris | None |
| 4. Sludge deposits | None |
| 5. Color and turbidity | Not objectionable |
| 6. Phenols or other taste producing substances | None |
| 7. Substances potentially toxic | None |
| 8. Free acids or alkalies | None |
| 9. Radioactivity | Within limits approved by the appropriate State agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between States involved. |
| 10. Coliform bacteria | Bacterial content of bathing waters shall meet limits approved by State Department of Health and acceptability will depend on sanitary survey. |

Class C

Suitable for recreational boating, irrigation of crops not used for consumption without cooking; habitat for wildlife and common food and game fishes indigenous to the region; industrial cooling and most industrial process uses.

| Items | Specifications |
|---|---|
| 1. Dissolved oxygen | Not less than 5 ppm |
| 2. Oil and grease | Not objectionable |
| 3. Odor, scum, floating solids or debris | None |
| 4. Sludge deposits | None |
| 5. Color and turbidity | Not objectionable |
| 6. Phenols or other taste producing substances | None |
| 7. Substances potentially toxic | Not in toxic concentrations or combinations |
| 8. Free acids or alkalies | None |
| 9. Radioactivity | Within limits approved by the appropriate State agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between States involved. |

Class D

Suitable for transportation of sewage and industrial wastes without nuisance, and for power, navigations and certain industrial uses.

| Items | Specifications |
|---|---|
| 1. Dissolved oxygen | Present at all times |
| 2. Oil and Grease | Not objectionable |
| 3. Odor, scum, floating solids, or debris | Not objectionable |
| 4. Sludge deposits | Not objectionable |
| 5. Color and turbidity | Not objectionable |
| 6. Substances potentially toxic | Not in toxic concentrations or combinations. |
| 7. Free acids or alkalies | Not objectionable amounts |
| 8. Radioactivity | Within limits approved by the appropriate State agency with consideration of possible adverse effects in downstream waters from discharge of radioactive wastes; limits in a particular watershed to be resolved when necessary after consultation between States involved. |

Note: Waters falling below these descriptions are considered as unsatisfactory and as Class E. These standards do not apply to conditions brought about by natural causes. For purpose of distinction as to use, waters used or proposed for public water supply shall be so designated.

# APPENDIX C

## MUNICIPAL WATER FACILITIES

## INVENTORY

TABLE 1

PRINCIPAL MUNICIPAL WATER SUPPLIES

CHAMPLAIN CANAL (Over 1000 Pop.)

| Community | Water Course Mileage | Present Treatment | Source | 1960 Census Pop. | Est. Pop. Served | Average Use MGD | Safe Yield MGD |
|---|---|---|---|---|---|---|---|
| Champlain Canal (Hudson River) | C | | | | | | |
| Waterford Twp. | C-1 | P-CalsoTcSb FrNgDcsKp | Hudson River | 4,316 | 4,850 | 0.71 | Unl. |
| Mechanicsville | C-9 | DcaMbSbFar Do | Reservoirs, Plum & Baker Brook | 6,831 | 7,500 | 0.85 | X |
| Stillwater | C-12 | I-AmClFp | Wells | 1,398 | 1,450 | 0.10 | X |
| Schuylerville | C-25 | Dh | Brooks; Springfield | 1,361 | 1,390 | 0.25 | X |
| Fish Creek | C-25 | | | | | | |
| Saratoga Springs | C-25-11 | P-AsDcCa TcSbFrsKp | Loughberry Lake | 16,630 | 15,500 | 3.00 | 6.0 |
| Batten Kill | C-26 | | | | | | |
| Greenwich | C-26 | Dh | Wells | 2,263 | 2,278 | 0.13 | 1.8 |
| Champlain Canal (Hudson River) | C | | | | | | |
| Fort Edward | C-37 | Dc | Springs & Brooks | 3,737 | 3,720 | 0.35 | Unl. |
| Hudson River | C-37 | | | | | | |
| South Glens Falls | C-37-5 | Dc | Springs & Wells | 4,129 | 4,500 | 0.60 | 0.8 |
| Glens Fall City | C-37-5 | Dc | Reservoirs, Brookfed | 18,580 | 21,700 | 4.50 | 6.0 |
| Hudson Falls | C-37-2 | DcVa | Wells & Brooks | 7,752 | 7,900 | 0.95 | 1.0 |
| Champlain Canal | | | | | | | |
| Whitehall | C-61 | Dc | Pine Lake | 4,016 | 3,900 | 0.75 | X |
| Other Supplies | | | | | 950 | 0.14 | |
| TOTALS | | | | | 74,688 | 12.19 | |

TABLE 2

PRINCIPAL WATER SUPPLIES (Over 1000 Pop.)

VERMONT SIDE OF LAKE CHAMPLAIN

| Community | Water Course Mileage | Present Treatment | Source | 1960 Census Pop. | Est. Pop. Served | Average Use MGD | Safe Yield MGD |
|---|---|---|---|---|---|---|---|
| Poultney R. (State Line) | L-62.0 | | | | | | |
| Fair Haven | V-L-62-11 | None | Inman Pond & Mountain Brook | 2,378 | 2,380 | 0.30 | X |
| Poultney | V-L-62-20 | Dc | Crystal Pond & Gr. Packed Well | 1,810 | 2,100 | 0.23 | 0.30 |
| Otter Creek | V-L-115 | | | | | | |
| Vergennes | V-L-115-6 | Dh | Mountain Brook | 1,921 | 1,920 | 0.20 | X |
| Middlebury | V-L-115-18 | Dh | Palmer Sp. Little Notch Br. & Well | 3,688 | 3,600 | 0.43 | 0.30 |
| Bristol | V-L-115-23 | None | Mountain Brook | 1,421 | 1,420 | 0.30 | 0.30 |
| Brandon | V-L-115-36 | Dh | Leicester & Bas. Br. Gr. Packed Well | 1,675 | 2,800 | 0.50 | 0.30 |
| Rutland | V-L-115-55 | Dc | Mendon Br. | 18,325 | 18,325 | 3.00 | 6.00 |
| West Rutland | V-L-115-55 | Dh | Mountain Br., Wells | 1,991 | 2,100 | 0.25 | 0.60 |
| Lake Champlain | L | | | | | | |
| Burlington | VL-131 | Dc,S,Fr,Dc,Ft | Lake Champlain | 35,531 | 50,000 | 4.26 | No Limit |
| Winooski R. | V-L-134 | | | | | | |
| Winooski | VL-134-5 | Dc,Ca,Mt,Sb, Fr | Springs & Wells | 7,420 | 8,700 | 0.50 | - |
| Essex Jct. Village | VL-134-14 | Dc,Vt | Indian Br. & Saxon Hill Reservoirs | 5,340 | 5,500 | 0.29 | X |
| Lake Champlain | L | | | | | | |
| St. Albans | V-L-156 | Dc | Brooks & Lake Champlain | 8,806 | 9,000 | 1.50 | No Limit |
| Missisquoi R. | V-L-171 | | | | | | |
| Swanton | V-L-171-5 | Dc,Vs | Fairfield Pond | 2,390 | 2,390 | 0.30 | X |
| Other Supplies | - | - | - | - | 5,505 | 0.67 | X |
| TOTALS | | | | | 115,740 | 12.73 | |

TABLE 3

PRINCIPAL WATER SUPPLIES (Over 1000 Pop.)

NEW YORK SIDE OF LAKE CHAMPLAIN

| Community | Water Course Mileage | Present Treatment | Source | 1960 Census Pop. | Est. Pop. Served | Average Use MGD | Safe Yield MGD |
|---|---|---|---|---|---|---|---|
| Lake George Outlet | NY-L-83 | | | | | | |
| Ticonderoga | NY-L-83-2 | Dc | Gooseneck Pond | 3,568 | 3,570 | 1.00 | 0.80 |
| Lake Champlain | NY-L | | | | | | |
| Port Henry | NY-L-99 | So,Fg,Dc | Bartlett Brook | 1,767 | 2,000 | 0.20 | X |
| Moriah (WD 1) | NY-L-99 | So,Dh | Bartlett Pond | - | 1,200 | 0.12 | X |
| Moriah (WD 2) | NY-L-99 | Dh | Roe Pond | - | 1,500 | 0.15 | X |
| Willsboro (WD 2) | NY-L-124 | Dh,Fd | Lake Champlain | | 1,715 | 0.17 | X |
| Ausable River | NY-L-136 | | | | | | |
| Keesville | NY-L-136-5 | Dc | Butternut Pond | 2,213 | 2,190 | 0.25 | X |
| Little Ausable River | NY-L-138 | | | | | | |
| Peru | NY-L-138-10 | Fd,Dc | Furnace Brook & Ausable River | 900 | 1,700 | 0.20 | X |
| Saranac River | NY-L-146 | | | | | | |
| Plattsburg | NY-L-146-10 | Dc,Mt,Vs,Sc, Fr,Fa,To,Kg | Saranac R., West Br., & Mead R. | 20,172 | 27,500 | 5.85 | 10.6 |
| Dannemora | NY-L-146-13 | Dh | Reservoir Sp. | 4,835 | 2,285 | 0.24 | X |
| Big Chazy River | NY-L-166 | | | | | | |
| Champlain | NY-L-166-7 | Dh | Big Chazy River | 1,549 | 1,550 | 0.24 | X |
| Lake Champlain | NY-L | | | | | | |
| Rouses Point | NY-L-171 | Dc | Lake Champlain | 2,160 | 2,400 | 0.50 | No Limit |
| Other Supplies | - | - | - | - | 4,645 | 0.51 | |
| TOTALS | | | | | 52,255 | 9.43 | |

PRINCIPAL MUNICIPAL WATER SUPPLIES
INDEX FOR TREATMENT

C - Chemical dosage for coagulation or softening
- Ca - alum
- Cl - lime
- Cs - soda ash
- Co - other coagulants or aids

D - Disinfection
- Dc - chlorine gas
- Dh - hypochlorites
- Ds - free residual chlorine in distribution system
- Dx - chlorine dioxide
- Do - other means

F - Filters
- Fa - anthracite
- Fd - diatomaceous earth
- Fg - gravity (slow)
- Fp - pressure
- Fr - gravity (rapid)
- Fs - sand

K - Chemical dosage for corrosion correction or water stabilization
- Kc - phosphate compounds
- Kp - alkali feed for pH adjustment

M - Mixing device or tank
- Ma - air agitation
- Mb - baffle mix
- Mp - slow mechanical mix
- Mt - rapid mechanical mix
- (MtpsSv) - "Liquon Reactor;" "Accelerator;" or "Precipitator"

N - Ammoniation
- Ng - ammonia gas

S - Sedimentation
- Sb - basin, baffled (other than inlet or outlet)
- Sc - covered basins (other than housed)
- Sm - mechanical sludge removal
- So - open basin (May be in plant building)

T - Chemical taste and odor control
- Tc - activated carbon
- To - other

V - Fluoride adjustment
- Va - hydrofluosilicic acid
- Vs - sodium silicofluoride
- Vt - sodium fluoride

# APPENDIX D

# MUNICIPAL AND INDUSTRIAL

# WASTE FACILITIES

# INVENTORY

TABLE 1

MUNICIPAL AND INDUSTRIAL WASTE FACILITIES
CHAMPLAIN CANAL

| Municipality or Industry | Water Course Mileage | 1960 Census Pop. | Est. Pop. Served | Average Daily Flow MGD | Treatment | PE Untreated Wastes | PE Discharged Wastes |
|---|---|---|---|---|---|---|---|
| Champlain Canal (Hudson R.) | C | | | | | | |
| Waterford | C-1 | 2,915 | 2,915 | .30 | N | 2,915 | 2,915 |
| Arsenal | C-1 | - | - | X | N | X | X |
| Stillwater S.D. #1 | C-6 | - | 350 | .04 | P & Cl | 350 | 225 |
| Mechanicsville | C-9 | 6,831 | 6,831 | .70 | P | 6,831 | 4,440 |
| W. Virginia Pulp & Paper | C-9 | - | - | X | N | 545,000 | 545,000 |
| Stillwater | C-12 | 1,398 | 1,398 | .15 | P & Cl | 1,398 | 910 |
| Fish Creek | C-25 | | | | | | |
| Saratoga Springs | C-25-11 | 16,630 | 16,630 | 2.00 | S | 16,630 | 2,495 |
| United Board & Carton Corp. | C-25-1 | - | - | X | N | X | X |
| Schuylerville | C-25 | 1,361 | 1,361 | .25 | P & Cl | 1,361 | 885 |
| Batten Kill | C-26 | | | | | | |
| Thomson Paper Mills Inc. | C-26 | - | - | X | N | 9,000 | 9,000 |
| United Paper Board | C-26 | - | - | X | N | 2,900 | 2,900 |
| Champlain Canal (Hudson R.) | C | | | | | | |
| Fort Miller Paper Co. | C-30 | - | - | X | N | 500 | 500 |
| Fort Edward | C-37 | 3,737 | 3,737 | X | N | 3,735 | 3,735 |
| Hudson River | C-37 | | | | | | |
| Marinette Paper Co. | C-37-1 | - | - | X | N | 5,800 | 5,800 |
| South Glens Falls | C-37-5 | 4,129 | 4,129 | .40 | P | 4,130 | 2,685 |
| Glens Falls | C-37-5 | 18,580 | 20,900 | 4.00 | P & Cl | 20,900 | 13,585 |
| Finch Pruyn Co. | C-37-5 | - | - | X | N | 9,000 | 9,000 |
| Imperial Paper Co., Inc. | C-37-5 | - | - | X | N | 5,000 | 5,000 |
| Hudson Falls | C-37-5 | 7,752 | 7,700 | .90 | P | 7,700 | 5,005 |

TABLE 2

PRINCIPAL MUNICIPAL WASTE FACILITIES
NEW YORK STATE SIDE OF LAKE CHAMPLAIN

| Municipality | Water Course | 1960 Census Pop. | Est. Pop. Served | Average Daily Flow MGD | Treatment | Discharge | P.E. Untreat. Waste | P.E. Dischg. Waste |
|---|---|---|---|---|---|---|---|---|
| Lake George Outlet | NY-L-83 | | | | | | | |
| Ticonderoga | NY-L-83-2 | 3,568 | 3,000 | X | None | Ticonderoga Creek | 3,000 | 3,000 |
| Lake Champlain | NY-L | | | | | | | |
| Port Henry | NY-L-99 | 1,767 | 1,750 | X | None | Lake Champlain & Mill Brook | | |
| Morian (SD. #2) | NY-L-99 | 5,837 | 2,400 | 0.24 | P | X | | |
| Westport | NY-L-110 | 723 | 700 | - | None | Lake Champlain | | 700 E |
| Ausable River | NY-L-136 | | | | | | | |
| Keesville | NY-L-136-5 | 2,213 | 300 | X | None | Ausable River | 300 | 300 |
| Ausable Forks | NY-L-136-17 | 2,026 | 500 | - | None | Ausable River | | 500 E |
| Little Ausable River | NY-L-138 | | | | | | | |
| Peru | NY-L-138-10 | 3,110 | 850 | 0.18 | P&Cl | Little Ausable River | | |
| Saranac River | NY-L-146 | | | | | | | |
| Plattsburg | NY-L-146-1 | 20,172 | 27,000 | 6.00 | P&Cl | Saranac River | | |
| Dannemora #1 | NY-L-146-16-6 | 4,835 | 1,500 | 0.20 | Septic Tank | Behan Brook | | |
| Dannemora #2 | NY-L-146-16-6 | - | 800 | - | None | Behan Brook | | |
| Dannemora Prison | NY-L-146-15 | 3,235 | 3,235 | 0.32 | P&Cl | Saranac River | | |
| Big Chazy River | NY-L-166 | | | | | | | |
| Champlain | NY-L-166-7 | 1,549 | 1,000 | 0.10 | P&Cl | Big Chazy River | | |
| Lake Champlain | NY-L | | | | | | | |
| Rouses Point | NY-L-171 | 2,160 | 2,160 | 0.30 | P | Lake Champlain | | |
| Unknown | | | | | | | | |
| Schroon Lake | | 800 | 150 | 0.16 | P&Cl | | | |
| | | | 45,350 | | | | | |
| | | | 7,050 | No Treat. | | | | |
| | | | 6,060 | Primary | | | | |
| | | | 32,240 | Primary & Cl | | | | |

TABLE 3

PRINCIPAL MUNICIPAL WASTE FACILITIES
VERMONT SIDE OF LAKE CHAMPLAIN

| Municipality | Water Course | 1960 Census Pop. | Est. Pop. Served | Average Daily Flow MGD | Treatment | Discharge | P.E. Untreat. Waste | P.E. Dischg. Waste |
|---|---|---|---|---|---|---|---|---|
| Poultney R. (State Line) | C-62.0 | | | | | | | |
| Fair Haven | V-L-62-11 | 2,058 | 1,800 | X | None | River Castleton | | |
| Poultney | V-L-62-16 | 1,800 | 1,500 | - | None | Poultney River | | |
| Otter Creek | V-L-115 | | | | | | | |
| Vergennes | V-L-115-6 | 1,921 | 1,800 | 0.4 | P&Cl | Otter Creek | | |
| Middleburry | V-L-115-18 | 3,688 | 3,400 | X | Plans Completer for Primary treatment | Otter Creek | | |
| Brandon | V-L-115-36 | 3,329 | 2,360 | X | P&Cl | Neshobe River | 2,360 | |
| Rutland | V-L-115-72 | 18,325 | 13,000 | 3.00 | P&Cl | | | |
| Lake Champlain | L | | | | | | | |
| Burlington (Main) | V-L-131 | 35,531 | 22,000 | 2.7 | P&Cl | Lake Champlain | | |
| North End Plant | | - | 6,200 | 0.5 | P&Cl | Winooski River | | |
| University Area Plant | | - | 7,000 | X | P&Cl | Winooski River | | |
| S. Burlington | V-L-129 | - | 750 | 0.04 | P&Cl | L. Champlain | | |
| Grand Isle | V-L-146 | 426 | 300 | - | P&Cl | L. Champlain | | |
| Winooski River | V-L-134 | | | | | | | |
| Winooski | V-L-134-5 | 7,420 | 7,000 | 0.5 | None | Winooski River | | |
| Essex Jct. Village | V-L-134-14 | 5,340 | 5,000 | X | P&Cl | Winooski River | | |
| Colchester | V-L-134-14 | - | 2,000 | X | None | Winooski River | | |
| Lake Champlain | L | | | | | | | |
| St. Albans | V-L-156 | 8,806 | 7,200 | 2.5 | S&Cl | Stevens Brook to Lake Champlain | | |
| Missisquoi R. | V-L-171 | | | | | | | |
| Swanton | V-L-171-5 | 2,390 | 1,500 | X | None | Missisquoi River | | |
| LaPlatte R. | | | | | | | | |
| Shelburne | V-L- -4 | - | 500 | 0.03 | P&Cl | | | |
| Total | | | 83,310 | | | No Treat. 17,200<br>P&Cl 58,910<br>Sec. 7,200 | | |

TABLE 4

INDUSTRIAL WASTE DISCHARGES
NEW YORK SIDE LAKE CHAMPLAIN

| Industries | Water Course Mileage | Type Wastes | Treatment | BOD Lbs./Day | Suspended Solids Lbs./Day |
|---|---|---|---|---|---|
| Lake Champlain | | | | | |
| Diamond Match Co. @ Plattsburg | NY-L-146 | White, water, ground wood loss machine spillage, and rinses | None | 140 | 350 |
| Big Chazy River | | | | | |
| Champlain, Creamery, Inc. | NY-L-166-7 | Evaporator condensate whey, spoiled skim, casein, rinses | None | - | - |
| Saranac River | NY-L-146 | | | | |
| Pal Blade Co. | NY-L-146-2 | Cutting oils, cyanides pickling acids | None | - | - |
| New York Gas & Elec Co. | NY-L-146-2 | Retort wastes | Settling Pond | 2 | 1 |
| Imperial Wallpaper Co. | NY-L-146-2 | White water, grinder losses, color roll rinses | None | 665 | 175 |
| Little Ausable River | NY-L-138 | | | | |
| Dairymen's League Milk Plant | NY-L-138-9 | Can rinses & spills | Septic tank | 30 | - |
| Bouquet River | NY-L-124 | | | | |
| NY & Penna. Pulp & Paper Co. @ Willsboro | NY-L-124-0.5 | Spent soda liquors, spent bleach, pulp felt washings | Ponding for spent sodas only | 2,400 | 1,200 |
| Lake Champlain | | | | | |
| Dairymen's League Milk Plant & Westport | NY-L-110 | Can rinses and spills | Septic tank | 5 | 4 |
| Aggregates Processing Co. @ Port Henry | NY-L-99 | Clay, stone dust, other wash, rinse materials | Settling on broad slopes of old iron mill tailings | - | 22,000 |
| Republic Steel Co. @ Mineville | NY-L-100 | Spent slurry from floatation and cooling facilities | Clarifies and settling pond | - | 3,500 |

TABLE 7.

INDUSTRIAL WASTE DISCHARGES
NEW YORK SIDE LAKE CHAMPLAIN
(Cont'd.)

| Industries | Water Course Mileage | Type Wastes | Treatment | BOD Lbs./Day | Suspended Solids Lbs./Day |
|---|---|---|---|---|---|
| Lake Champlain (Cont'd.) | | | | | |
| Dairymen's League Milk Station | NY-L-71 | Can rinses and spills | Septic Tank | 9 | 3 |
| Lake George Outlet | NY-L-83 | | | | |
| Int'l Pulp & Paper Co. (Main mill) | NY-L-83-2 | Spilled Kraft liquors, spent bleach, fibre rinses | Save-alls & evaporators | 9,000 | 1,150 |
| Int'l Pulp & Paper Co. (Island mill) | NY-L-83-2 | White water | Save-alls | 1,175 | 640 |

From N. Y. Classification Report 1954, P. 65, Table 13.

TABLE 5

INDUSTRIAL WASTE DISCHARGES
VERMONT SIDE OF LAKE CHAMPLAIN

| Industries | Water Course Mileage | Type Wastes | Treatment | P.E. to Water Course |
|---|---|---|---|---|
| Poultney River | V-L-62.0 | | | |
| Dairy @ Fairhaven | V-L-62-11 | Milk | None | 200 |
| State Co. @ Fairhaven | V-L-62-11 | Slate | Lagoons | |
| Pringle Brook | V-L-120 | | | |
| Milk Receiving Station @ Charlotte | V-L-120-4 | Milk | None | 125 |
| LaPlatte River | V-L-124 | | | |
| Cheese Plant @ Hinesburg | V-L-124-10 | Cheese | None | 7,300 |
| Winooski River | V-L-134 | | | |
| Cheese Plant @ Richmond | V-L-134-26 | Cheese | None | |
| Dairy @ Essex Junction | V-L-134-14 | Milk | | 300 |
| Indian Brook | V-L-137 | | | |
| Milk Receiving Station @ Colchester | V-L-137-5 | Milk | None | 50 |
| Lamoille River | V-L-140 | | | |
| Dry Milk & Cream Plant @ Milton | V-L-140-8 | Milk | None | 600 |
| Mill Rugg Brook | V-L-156 | | | |
| Milk Receiving Station @ St. Albans | V-L-156-2 | No Waste | None | 400 |
| Missisquoi River | V-L-171 | | | |
| Paperboard Mill @ Sheldon | V-L-171-12 | Paper | None | 8,000 |

From N.Y.N.E. I.A.C. "Lake Champlain Drainage Basin" Table 26, pV-67 to V-74

APPENDIX E

P. H. S. FIELD DATA OF WATER QUALITY

CHAMPLAIN CANAL

OCTOBER 1963

P. H. S. Field Data of Water Quality

Champlain Canal

October 1963

| Station River Mile | Date | Time Est. | Temp. C. Air | Temp. C. Sample | pH | Conduct UMHOS/CM | D.O. MG/L | Alk. MG/L | Chloride MG/L | C.O.D. MG/L | MF Bacteria/100ML Coliform | MF Bacteria/100ML Fecal Strep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .3-C | 10-02-63 | 1125 | 21 | 16.2 | 7.2 | 150 | 7.3 | 28 | 30 | 49 | 29E3 | 80E1 |
| .3-C | 10-04-63 | 1515 | 17 | 16.0 | 7.3 | 120 | 7.8 | 28 | - | 53 | 24E3 | 68E1 |
| 4.4-C | 10-02-63 | 1210 | 21 | 16.8 | 7.0 | 125 | 6.9 | 24 | 30 | 51 | 11E3 | 76E1 |
| 4.4-C | 10-04-63 | 1425 | 16 | 15.5 | 7.3 | 120 | 7.5 | 28 | - | 58 | 48E2 | 20E1 |
| 7.6-C | 10-02-63 | 1310 | 25 | 16.9 | 6.8 | 160 | 7.2 | 24 | - | 78 | 68E2 | 67E1 |
| 7.6-C | 10-04-63 | 1355 | 18 | 15.6 | 7.1 | 120 | 7.7 | 24 | - | 70 | 30E2 | 28E1 |
| 9.0-C | 10-04-63 | 1335 | 16 | 15.6 | 7.3 | 120 | 8.2 | 22 | - | 80 | 39E2 | 48E1 |
| 9.9-C | 10-02-63 | 1350 | 23 | 17.4 | 7.2 | 100 | 8.8 | 21 | - | 28 | 44E1 | 30E0 |
| 9.9-C | 10-04-63 | 1305 | 15 | 15.4 | 7.4 | 100 | 8.6 | 20 | - | 46 | 30E2 | 20E0 |
| 19.2-C | 10-02-63 | 1505 | 25 | 16.2 | 6.8 | 90 | 8.1 | 19 | - | 29 | 14E3 | 20E0 |
| 19.2-C | 10-04-63 | 1155 | 13 | 12.9 | 7.1 | 80 | 7.7 | 15 | - | 41 | 12E3 | 70E0 |
| 24.8-C | 10-02-63 | 1545 | 26 | 16.5 | 6.8 | 90 | 8.6 | 16 | - | 36 | 38E3 | 25E1 |
| 24.8-C | 10-04-63 | 1100 | 13 | 15.4 | 7.0 | 80 | 8.0 | 13 | - | 45 | 28E3 | 20E0 |
| 29.6-C | 10-02-63 | 1640 | 25 | 16.7 | 6.4 | 80 | 7.5 | 11 | - | 41 | 56E3 | 70E0 |
| 29.6-C | 10-04-63 | 1030 | 12 | 15.3 | 6.8 | 70 | 6.9 | 9 | - | 45 | 65E3 | 18E1 |

P. H. S. Field Data of Water Quality

Champlain Canal

October 1963

(Cont'd)

| Station River Mile | Date | Time Est. | Temp. C. Air | Temp. C. Sample | pH | Conduct UMHOS/CM | D.O. MG/L | Alk. MG/L | Chloride MG/L | C.O.D. MG/L | MF Bacteria/100ML Coliform | MF Bacteria/100ML Fecal Strep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.4-C | 10-04-63 | 1005 | 12 | 15.0 | 6.7 | 70 | 4.7 | 9 | - | 43 | 10E3 | 10E0- |
| 32.7-C | 10-02-63 | 1715 | 23 | 16.7 | 6.2 | 80 | 6.1 | 8 | - | 45 | 91E3 | 24E1 |
| 32.7-C | 10-04-63 | 950 | 12 | 15.0 | 6.7 | 80 | 5.3 | 10 | - | 43 | 11E4 | 48E1 |
| 36.7-C | 10-02-63 | 1810 | 24 | 16.6 | 6.3 | 75 | 7.5 | 9 | - | 45 | 48E3 | 48E1 |
| 36.7-C | 10-04-63 | 915 | 11 | 14.6 | 6.6 | 100 | 6.4 | 7 | - | 48 | 68E3 | 12E2 |
| 37.6-C | 10-03-63 | 930 | 15 | 14.6 | 7.5 | 125 | 8.4 | 25 | - | 30 | 49E1 | 10E1 |
| 37.6-C | 10-03-63 | 1915 | 15 | 14.6 | 7.6 | 110 | 8.8 | 22 | - | 32 | 26E1 | 90E0 |
| 44.8-C | 10-03-63 | 1200 | 20 | 15.8 | 7.6 | 90 | 8.3 | 14 | - | 45 | 37E1 | 20E0 |
| 44.8-C | 10-03-63 | 1810 | 15 | 15.0 | 7.3 | 80 | 9.0 | 13 | - | 43 | 21E1 | 80E0 |
| 49.5-C | 10-03-63 | 1310 | 21 | 15.4 | 7.4 | 100 | 8.5 | 28 | - | 32 | 44E2 | 65E1 |
| 49.5-C | 10-03-63 | 1725 | 16 | 14.4 | 7.4 | 100 | 9.0 | 29 | - | 33 | 36E2 | 61E1 |
| 54.4-C | 10-03-63 | 1335 | 20 | 14.8 | 7.4 | 130 | 8.3 | 37 | - | 25 | 32E2 | 21E1 |
| 54.4-C | 10-03-63 | 1700 | 16 | 14.4 | 7.5 | 125 | 8.6 | 39 | - | 36 | 34E2 | 13E1 |
| 59.4-C | 10-03-63 | 1430 | 20 | 14.7 | 7.7 | 150 | 9.0 | 54 | - | 29 | 30E4 | 46E1 |
| 59.4-C | 10-03-63 | 1605 | 17 | 14.6 | 7.7 | 150 | 8.9 | 45 | - | 27 | 44E4 | 11E2 |



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